BEFORE THE ENVIRONMENT COURT
I MUA I TE KOOTI TAIAO O AOTEAROA

ENV-2018-CHC-26 to 50

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of appeals under clause 14 of Schedule 1 to the Act relating to the proposed Southland Water and Land Plan

BETWEEN **WAIHOPAI RŪNAKA, HOKONUI RŪNAKA, TE RŪNANGA O AWARUA, TE RŪNANGA O ORAKA APARIMA, and TE RŪNANGA O NGĀI TAHU (collectively NGĀ RŪNANGA)**

Appellants in ENV-2018-CHC-47

AND **SOUTHLAND REGIONAL COUNCIL**

Respondent

STATEMENT OF EVIDENCE OF DR JANE CATHERINE KITSON

ON BEHALF OF NGĀ RŪNANGA (WAIHOPAI RŪNAKA, TE RŪNANGA O AWARUA, TE RŪNANGA O ŌRAKA APARIMA, AND HOKONUI RŪNAKA) AND TE RŪNANGA O NGĀI TAHU

Environmental science/ Mātauranga Maori

15 February 2019

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No Murihiku au

Ko Jane Kitson ahau

1. My name is Dr Jane Catherine Kitson.

2. I was born in Lumsden. At the time my father was a top-dresser pilot and my mother a venison processor based in Mossburn. It is through my father that I whakapapa to Murihiku/Rakiura (Stewart Island). Both my mother's and father's Pākehā lines have strong links to the south, as whalers/sealers, goldminers, farmers and entrepreneurs.

3. I am a mother of two young sons (Luke, 13 and Trent, 11) and our family has a strong interest in mahinga kai and hunting and gathering pursuits including tītī harvesting, trout and salmon fishing, duck and deer hunting, and kai moana gathering.

4. I am a member of Te Rūnanga o Ōraka- Aparima and also whakapapa to Te Rūnanga o Awarua and Waihōpai Rūnaka. I am a member of the Ōraka-Aparima Taiao Roopu (environmental group) and have the privilege of working with and learning from the kaumatua in this roopu.

5. I am the director of an environmental consultancy (Kitson Consulting Ltd).

6. Previously I have been the Senior Environmental Advisor Mahinga Kai – Freshwater Monitoring at Te Rūnanga o Ngāi Tahu, based in Waihōpai/Invercargill.

7. I have also previously worked at Te Ao Marama Incorporated (TAMI), as an environmental scientist for a year and half. Prior to this I was employed by Environment Southland for nearly 9½ years in the roles of environmental scientist – reporting (project manager for both the coastal marine and freshwater state of the environment reports), coastal scientist, and senior surface-water scientist.

8. Before working at Environment Southland, I was employed by the Te Waiau Mahika Kai Trust as its project manager. In that role, I managed the Trust's mahinga kai restoration projects.

9. I hold the degrees of Bachelor of Science, Masters of Science (Zoology) and Doctor of Philosophy (Zoology) from the University of Otago. I have undertaken and passed the "Making Good Decisions" course to qualify as an RMA Hearings Commissioner and have subsequently acted as a commissioner. I am a member of the New Zealand Freshwater Sciences Society.

10. I have also been a member of the Ministry for the Environment science review panel, iwi science panel and on the expert panels, where I was involved in developing revisions to the National Objectives Framework (**NOF**) for the National Policy Statement for Freshwater Management (**NPSFM**), including the 2017 amendments.

11. I am a Ngāi Tahu representative on the Guardians of Lakes Manapōuri, Monowai and Te Anau, a board member of Ngā Pae o te Māramatanga: New Zealand's Centre of Research Excellence, a member of the Research Advisory Committee of Seafood Innovations Limited and a research assessor for the Ministry of Business, Innovation and Employment (**MBIE**).

12. I have worked in a range of research and mahinga kai management projects including doctoral research on traditional ecological knowledge and harvest management of tītī/muttonbirds (*Puffinus griseus*); microbial food webs in lakes; research on kanakana/lamprey (*Geotria australis*), and the use of mātauranga Māori to monitor population trends.

13. I currently co-lead an MBIE-funded research programme: 'Ngā Kete o te Wānanga: Mātauranga Maori, Science and Freshwater Management', which is looking at the synergies of science and mātauranga Māori for improved freshwater management. The Murihiku-based case study within this research programme is developing a Murihiku Cultural Water Classification System, which will be informed by cultural and science monitoring tools.

14. I also co-lead an MBIE-funded research project on kanakana/lamprey habitat bottlenecks. This project is based in the Waikawa Catchment in Southland.

15. For the majority of my career, my work has revolved around working with Ngā Rūnanga whānau, to respectfully bring science-based knowledge and mātauranga Māori together to support their goals and aspirations for mahinga kai and freshwater management.

16. I have been asked by Ngāi Tahu to prepare evidence for this hearing. More specifically, I have been asked to provide technical evidence that draws on Southland environmental state and trend datasets (conducted by organisations such as Environment Southland and the National Institute of Water and Atmospheric Research (**NIWA**)) and interpret these within a Ngāi Tahu freshwater management paradigm of Ngā Rūnanga cultural values, uses and associations.

17. I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2014 and I agree to comply with it. My qualifications are set out above.

18. As a member of the New Zealand Freshwater Sciences Society, a constituent organisation of the Royal Society of New Zealand - Te Apārangi, I also agree to be bound by the Royal Society of New Zealand Code of Professional Standards and Ethics in Science, Technology, and the Humanities.[1]

19. The data, information, facts and assumptions I have considered in forming my opinions are set out in my evidence. The reasons for the opinions expressed are also set out in my evidence.

20. Other than where I state I am relying on the evidence of another person, my evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

[1] Code of Professional Standards and Ethics in Science, Technology and the Humanities (1 January 2019).

21. I am a member of Te Rūnanga o Oraka-Aparima and also whakapapa to Te Rūnanga o Awarua and Waihopai Rūnaka. My expertise is partially derived from those cultural associations. I note that whilst I am of Ngāi Tahu descent, I am required to be impartial and unbiased in my professional opinions expressed.

22. For the avoidance of any perceived conflicts, I advise that my husband, Zane Moss, is providing evidence for Fish and Game New Zealand in Topic B.

SCOPE OF EVIDENCE

23. My evidence will address the Southland environmental state and trend datasets, within a Ngāi Tahu freshwater management paradigm of Ngā Rūnanga cultural values, uses and associations. More specifically, I will address the following matters:

    (a) Ngā Rūnanga values, uses and associations with Southland waterways;
    (b) Water quality and ecosystem state and changes from a Ngāi Tahu paradigm;
    (c) Use of cultural indicators and tools available; and
    (d) The effects of hydro-electric developments.

24. In preparing my evidence, I have read and considered a number of documents, which are referenced throughout my evidence, and a complete list of references is set out in Appendix A.

25. I have attached the following documents to my evidence:

    (a) **Appendix A:** References;
    (b) **Appendix B:** Figures 1 to 9;
    (c) **Appendix C:** Table 1: Ecological importance of some culturally important mahinga kai species;
    (d) **Appendix D:** Table 2: Some of the parameters used by Environment Southland to monitor states and trends; and
    (e) **Appendix E**: State and Trends.

EXECUTIVE SUMMARY

26. Mahinga kai is a central pillar to Ngāi Tahu ki Murihiku identity, cultural health and wellbeing.

27. Mahinga kai has many environmental and water-related dependencies. These dependencies can be categorised into:

(a) the environmental dependencies/attributes of the mahinga kai species; and

(b) environmental dependencies/attributes of the mahinga kai activity.

28. Environmental degradation impacts on mahinga kai species and the activity of mahinga kai.

29. Te Mana o te Wai is a matter of national significance in the National Policy Statement for Freshwater Management. To uphold this requires the provision for Te Hauora o te Taiao (the health of the environment), Te Hauora o te Wai (the health of the waterbody) and Te Hauora o te Tangata (the health of the people).

30. Using these key needs for Te Mana o te Wai, I examine the impacts upon them by the current state of the environment. To do this I examine the readily available data provided by Environment Southland and the Land Air Water Aotearoa (**LAWA**) website, and published materials.

31. Current science indicators, thresholds/standards and monitoring sites are not congruent with those required to assess the needs of cultural values. Ngāi Tahu indicators of health and cultural monitoring are required to enable better facilitation of Ngāi Tahu and mātauranga Māori into freshwater management processes and decisions.

32. However, the existing datasets show that the current state of Southland waterways is not meeting the cultural health and wellbeing needs of Ngāi Tahu ki Murihiku.

33. In my opinion, the current freshwater state fails to meet the needs of the environment and the health of the people. Considering that Te Mana o te Wai requires putting the health of the Wai as the highest priority, then this failure means that Te Mana o te Wai is not supported.

NGĀ RŪNANGA VALUES, USES AND ASSOCIATIONS WITH SOUTHLAND WATERWAYS

34. Ms Cain and Mr Skerrett have provided evidence on the uses, values and associations to the waterways in Southland. They have also provided evidence on the importance of mahinga kai to Ngā Rūnanga relationships with their cultural landscape, sites, water, taonga, species and resources, and to their cultural, spiritual, social and economic well-being and cultural identity.

35. Mahinga kai encompasses the resource harvested, the ability to access the resource, the site where gathering occurs, the act of gathering and using the resource, and the good health of the resource.[2]

36. The health and wellbeing of all waterways in Southland is important to Ngāi Tahu whānui. There are a number of statutory mechanisms that have been put in place across Southland waterways that recognise the importance and associations with Ngāi Tahu whānui. These include those provided for in the Ngāi Tahu Claims Settlement Act 1998, Mātaitai reserves,[3] Water Conservation Orders[4] and archaeological sites (refer to Mr Skerrett's evidence at paragraph 52). The Statutory recognised areas are of importance to Ngāi Tahu whānui, and are shown in Figure 1 (**Appendix B**).

37. However, it is important to understand that during the Settlement negotiation process, the Crown did not recognise all sites or all taonga species that were considered important for by mana whenua (refer to Mr Skerrett's evidence at paragraph 58).

THE CONNECTION BETWEEN NGA RŪNANGA VALUES AND THE STATE OF THE ENVIRONMENT

38. Ngāi Tahu values, uses and associations have a number of attributes that are influenced by and should be considered in freshwater management decision-

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2 Tipa. 2011.

3 Fisheries (South Island Customary Fishing) Regulations 1999.

4 Water Conservation (Oreti River) Order 2008, section 4(d): *significance in accordance with tikanga Māori.*

making processes. Figures 2 and 3 (**Appendix B**) illustrate some of the attributes associated with mahinga kai.

39. Mahinga kai has many environmental and water-related dependencies. These dependencies can be categorised into:

(a) the environmental dependencies/attributes of the mahinga kai species (e.g., Figure 2 **Appendix B**); and

(b) environmental dependencies/attributes of the mahinga kai activity (e.g., Figure 3 **Appendix B**).

40. Environment dependencies of mahinga kai species (Figure 2, **Appendix B**) include water (quality and quantity); sediment, nutrients, dissolved oxygen, water temperature, habitat condition and habitat condition of prey/associated species, toxicants, flow regime and habitat connectivity.

41. Freshwater mahinga kai species are also dependent on their interactions with other species (marine, estuarine, freshwater and terrestrial). Some of these interactions are illustrated in the food web diagram (Figure 4, **Appendix B**).

42. Many mahinga kai species have complex life-cycles that require access to marine, estuarine and freshwater environments. Figures 5 to 7 (**Appendix B**) illustrate the life-cycles of the following mahinga kai species: tuna (freshwater eels), kanakana (lamprey), and waikakahi/freshwater mussel.

43. Each stage in the life-cycle requires specific habitat conditions to be available. This includes appropriate fish passage (connectivity) between different ecosystem types (e.g. wetlands, tributaries, rivers, lakes, estuaries and man-made habitats such as drains). These ecosystems must also be in good condition.

44. As discussed by Ms Cain and Mr Skerrett, Ngāi Tahu articulate the necessity for considering a landscape in its entirety 'Ki Uta Ki Tai'. Ki Uta Ki Tai acknowledges that rivers connect the entire landscapes from the mountains to the sea, and conversely that rivers are linked to the whenua/land. Most importantly, this framework acknowledges the overall health of a river can be affected by the deterioration at one point of its length i.e. what happens at one point can affect all parts of the catchment, and further, all parts of the surrounding environment.[5]

45. The ethos of this is well illustrated when considering the dependencies of indigenous fish, the majority of these species migrate in the transition spaces between freshwater and the sea (estuaries), for part of their life cycles. This is shown in Figure 8 (**Appendix B**). It is common for species to be in estuarine habitats in the most vulnerable parts of their life cycle when they transition between freshwater to saline environments.

46. As such, reduction in habitat quality and extent can constrain a species' ability to survive, reproduce or recruit to the next life stage. Therefore, it is important to consider the ecosystem health of connected ecosystems when considering mahinga kai/ecology. For indigenous fish species the consideration of estuarine habitat is crucial.

47. For species like inanga (one of the whitebait species) spawning areas can be mapped. Environment Southland has done some work on this in Southland Rivers.[6] Research aimed at mapping and identifying kanakana/lamprey spawning and adult habitats in Southland is also being conducted.[7] Understanding areas for spawning and the timing of this can provide practical information for the protection of taonga species and their habitat.

48. Waikakahi/freshwater mussels' parasitic larval stage is reliant on a host fish to complete their life-cycle (Figure 7, **Appendix B**). These host fish species include kōaro, giant bully, common bully, and longfin and shortfin eels.[8] If the ecosystem does not support the host fish species, then this impacts on the life cycle of waikakahi.

49. High flows (e.g. natural flood events) also prompt the migratory behaviours of some mahinga kai species such as kanakana and tuna, so man-made interference with natural environmental flow regimes may impact on the intensity and success of mahinga kai migrations.[9]

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5 Corry and Puentener 1993; Kitson 2014; Kitson 2015; Kitson *et al.* 2014.

6 Hicks *et al.* 2013.

7 Williams *et al.* 2017.

8 Clearwater unpubl. data; Hine 1978, Percival 1931 cited in Phillips 2007.

9 Boubée *et al.* 2001, Crow *et al.* 2013, David and Closs 2002, Jellyman *et al.* 2002, McDowall 1990.

50. Impacts on the abundance and condition of mahinga kai populations include: [10]

(a) sedimentation;

(b) reduction in habitat quality/quantity (caused by land-use change, water abstraction, or drain clearance);

(c) river modifications (e.g. channelisation, flood control, hydro-generation schemes and other infrastructure);

(d) water quality deterioration and eutrophication;

(e) harvest, and removal of vegetation providing shade and shelter;

(f) barriers to fish passage,

(g) pollution events;

(h) parasites and disease; and

(i) pest fish and plants.

51. In addition to being culturally significant, freshwater species also play key ecological roles in freshwater ecosystems (Table 1, **Appendix C**). As such, their recognition and prioritisation in management will help sustain the cultural value in freshwater ecosystems.[11]

52. The activity of mahinga kai relies on the harvested species being present, abundant, in good condition, physically accessible, desirable to harvest and safe to consume and gather (refer to Mr Skerrett's evidence, particularly at paragraphs 61 and 88). Physical and legal conditions must also enable access and the ability to use preferred sites and methods (Figure 3, **Appendix B**).

53. Impacts from land-use activities on the practice of mahinga kai include high pathogen load in the waterways and/or toxic algae (which makes it unsafe for harvesters); bank stability and excess sediment (which can impact the ability to use a preferred harvest method safely, e.g. netting or spearing); and excessive pest plants and algae (which can foul nets, make rocks slippery and decrease visibility).

54. These points illustrate some of the consequences of environmental degradation for mahinga kai species and the activity of mahinga kai. This in turn impacts on other Ngāi Tahu core values (such as which are discussed in depth by Ms Cain

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10 Williams *et al.* 2017.

11 Noble *et al.* 2016.

and Mr Skerrett) and the cultural well-being of Ngāi Tahu whanau (Figure 9, **Appendix B**).

55. Finally, I wish to highlight that Ngāi Tahu have had a long standing, intergenerational concern with pollution and its effects on mahinga kai (refer to Ms Cain's evidence at paragraphs 65-69).

WATER QUALITY AND ECOSYSTEM STATE AND CHANGES FROM A NGĀI TAHU PARADIGM

56. In this section, I examine the current state of water quality and ecosystem health (drawing on existing freshwater research and monitoring conducted by organisations such as Environment Southland and NIWA). I also interpret Southland environmental state and trend datasets within a Ngāi Tahu freshwater management paradigm, which is based on Nga Rūnanga cultural values, uses and associations.

57. I have utilised data, state and trend information from the following sources: Environment Southland's 2017 report- *Water Quality in Southland: Current State and Trends;*[12] Environment Southland's poster for the 2016 Freshwater Sciences Society conference *State and Trends in Freshwater Macroinvertebrate Community Health in Southland*;[13] LAWA;[14] various Environment Southland reports; the evidence provided by Environment Southland to the Court and various published scientific papers and documents (these will be cited in the text).

58. The parameters of this section of my evidence are predominantly informed by data availability. Table 2 (**Appendix D**) contains a list of some attributes used by Environment Southland to monitor ecosystem states and trends. These attributes are used to inform sections and summaries in my evidence.

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[12] Hodson *et al.* 2017.

[13] Hodson and Arkbaripasand 2016.

[14] www.lawa.org.nz

59. It is very important to recognise that:

(a) no national or regional guidelines or standards have been developed to support a culturally relevant assessment of environmental state; and that

(b) no research has been undertaken to confirm whether the NPSFM attribute states (in Appendix 2 NPSFM) and New Zealand Environment and Conservation Council (**NZECC**) trigger values adequately protect mahinga kai species and activities, or whether they necessarily fulfil the Crown's responsibility with respect to the Ngāi Tahu Deed of Settlement.

60. I do not accept that using the datasets provided by regional council monitoring programmes, the NPSFM attribute states, and the Australian and New Zealand Environment and Conservation Council (**ANZECC**) trigger values will adequately describe the state of Murihiku waterways to a quality that meet the needs of Ngāi Tahu (such as mahinga kai standards).

61. As an example, the NPSFM Nitrate and Ammonia toxicity bottom-line is at the point where there is a risk of death for sensitive species. This would be considered too low a threshold to use as a baseline for Ngāi Tahu whānau. At the attribute state of B and C there starts to be a chronic impact on 5% and 20% respectively of the most sensitive species (mainly fish). Such an impact is not acceptable to Ngāi Tahu, and clearly fails to meet the requirement to ensure Te Mana o te Wai.

62. Similarly, just as NPSFM attribute states and ANZECC trigger values[15] may not safeguard Ngāi Tahu values, the distribution of regional council water quality monitoring sites does not appropriately represent areas that tangata whenua value. Therefore, interpretation of statistics around the proportion of sites showing an increasing or decreasing trend for any attribute, or within different bands, may not reflect cultural expectations and aspirations of iwi. To help address this issue I present the results within Freshwater Management Units in Tables 4a, 4b, 5a, 5b in Appendix E to help show results in way more parallel to (but not the same as) a Ki Uta Ki Tai framework.

[15] ANZECC 2000.

63. Te Mana o te Wai is a matter of national significance under the NPSFM (refer to Ms Cain's evidence at paragraph 84):[16]

> *Upholding Te Mana o te Wai acknowledges and protects the mauri of the water. This requires that in using water you must also provide for Te Hauora o te Taiao (the health of the environment), Te Hauora o te Wai (the health of the waterbody) and Te Hauora o te Tangata (the health of the people).*

64. When looking at the state of the environment and considering Te Mana o te Wai from a Ngāi Tahu paradigm, other measures such as habitat; flow; species presence/abundance/condition; whether species are "safe to eat"; and whether there is the ability to harvest those species using the preferred harvest method would also be included. These are the types of indicators/monitoring that would be required for a more comprehensive and culturally relevant assessment of environmental state.

65. In the evidence below, I highlight the results for *E. coli*, due to the recent updates in the NPSFM. The results of environmental state for some other variables have been covered within the Environment Southland evidence (Table 2, **Appendix D**), so instead of discussing those results, I have linked them to the attributes required for Te Mana o te Wai, mahinga kai species and mahinga kai activity.

66. For *E.coli*, Total Nitrogen, TON, Dissolved Reactive Phosphorous and Total Phosphorous I also compared the attribute state to the minimum acceptable level or trigger value, expressed as the ratio of the median state to the minimum acceptable level/trigger value. This ratio or magnitude highlights how close the current state is to these thresholds (Tables 3, 4b, 5a, 5b and Figure 10, **Appendix E**).

67. The methodology used to monitor and determine state and trends in the Environment Southland reports and the LAWA website are described in the evidence provided for Environment Southland by Mr Hodson (River and stream ecosystem health), and Mr Ward (Lake and Estuary ecosystem health).

[16] NPSFM 2014 (2017 update) p 7.

68. The Environment Southland 'State' time period used in this section is the same as those used by:

(a) Hodson et al 2017 for River and Lake Water quality: (2012 to 2016), and

(b) Hodson and Akbaripasand 2016 for Macroinvertebrate Community Index (**MCI**): (summer of 2009/2010 to the summer of 2013/14).

69. Environment Southland conducted trend analysis for the river water quality over three time periods: January 2000 – December 2016 (17 years); January 2007 – December 2016 (10 years); and: January 2012 – December 2016 (5 years). [17]

70. In this evidence, I have used the trend analysis from the time period between January 2000 – December 2016. The time period of 17 years is more closely aligned (when compared to the 10 and 5 year time periods) to Ngāi Tahu's aspirations for the contemporary environmental state. It also aligns more closely with:

(a) the fact it has just over twenty years since the signing of the Ngāi Tahu Deed of Settlement;[18] and

(b) the intergenerational management aims of Ngā Rūnanga whereby "*Ngāi Tahu ki Murihiku, as kaitiaki, work actively to ensure that spiritual, cultural and mahinga kai values of the takiwā are upheld and sustained for future generations. This is reflected in part within the Ngāi Tahu whakataukī/ proverb: Mō tātou, ā, mō ngā uri ā muri ake nei (For all of us and the generations that follow).*" [19]

71. The LAWA state time period used in this section is 2013-2017 and the 10-year trend is over 2008-2017. Five-year trends are reported on LAWA, however trend analysis over longer time periods have the advantage of being generally more robust than over shorter time periods (refer to Mr Hodson's evidence paragraph 50).

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17 Hodson *et al.* 2017.

18 The Ngāi Tahu Deed of Settlement was signed on the 21 November 1997, and subsequently passed into legislation as the Ngāi Tahu Claims Settlement Act on the 1st of October 1998.

19 Ngāi Tahu ki Murihiku 2008, p 50.

72. As stated in Mr Hodson's evidence the methods employed in Hodson and Arkbaripasand 2016, Hodson et al 2017 and LAWA differ, and as such they cannot be directly compared (paragraph 46). These methodological differences are described in Mr Hodson's evidence (paragraphs: 46 to 49).

STATE OF NGĀ RŪNANGA VALUES AND TE MANA O TE WAI

Te Hauora o te Tangata (the health of the people)

73. It is important to understand that Maori have holistic understandings of hauora (health). A model used to explain the dimensions of hauora is Te Whare Tapa model. This model illustrates health as the four walls of a wharenui (meeting house): wairua (spirit), hinengaro (mind), tinana (body), and whānau (family). The strength and balance of all four dimensions are essential to ensure the health and wellbeing. The environment provides for the foundations of these four walls.[20] If the health of the water and environment is poor then this in turn impacts on the health of the people. My evidence below focuses on the indicators for primary contact with water, but it is important to acknowledge the interconnectedness of Maori health.

74. Cultural use and identity are crucial to health and wellbeing. Access to waterways for cultural use, including mahinga kai, relies heavily on the water being safe for 'primary contact' - the ability to swim and immerse oneself in the water without the risk of getting sick. This requirement is expressed within the evidence of Ms Cain at paragraph 73 and the Murihiku Iwi Management plan.[21] It is also expressed in the statements that I have heard personally at various hui and wānanga undertaken with Ngāi Tahu ki Murihiku whānui over the last 20 years.

75. In 2016 Te Rūnanga o Ngāi Tahu, as part of the national freshwater reforms, made a submission to the Ministry for the Environment that "swimmable" should be the minimum acceptable state of all rivers. [22] However, I must note that the minimum acceptable state for immersion may not meet the aspirations of all Ngāi

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[20] Durie 1994; Durie 1999; TAMI 2009; ES and TAMI 2014.

[21] Ngāi Tahu ki Murihiku 2008.

[22] Te Runanga o Ngāi Tahu submission on MfE 'Next steps for freshwater' proposals. - 2016 http://www.mfe.govt.nz/fresh-water/reform-programme/freshwater-reforms-2016/feedback-fresh-water-reforms-2016

Tahu whānui, especially when the need for water to be drinkable where it once was has been articulated.[23]

76. My experience of mahinga kai gathering is that it is very whanau focussed. Invariably, one of my children will undertake full immersion, intentionally or otherwise. In addition, in my mahinga kai research and monitoring I have needed to set nets by swimming. Therefore, in my personal experience, the minimum water quality standard for mahinga kai needs to be for swimming and immersion.

77. The 2017 amendments to the NPSFM have changed the way the compulsory value of human health is to be assessed.[24] The assessment has moved away from a distinction between 'primary' and 'secondary' contact to assigning five different grades or attribute states (A, B, C, D, E) that indicate the degree of risk to human health from a Campylobacter infection from microbial contamination (using *E. coli* as the indicator).

78. There are four different statistical measures required to establish an attribute state. However, for all the categories considered 'swimmable' (bands A, B, C),[25] the median concentration of *E. coli* is required to be less than or equal to 130 *E. coli* per 100 ml.[26] I have reported this value in my evidence using attributes state/grades and the measure of what is considered 'swimmable' (median of ≤ *130 E. coli* per 100 ml).

(i) *E. coli*

79. *Escherichia coli* is used as an indicator of the risk of getting a Campylobacter infection from contact recreation in freshwater.

80. The assessment by Hodson *et al*. 2017 of *E.coli* pre-dates the 2017 NPSFM amendments that introduced swimmability grades/ attribute states. These were assessed in the LAWA 2018 trend updates, so I have used these results in Table 3 (**Appendix E**) to illustrate the state within each FMU and in the evidence below.

23 Ngāi Tahu ki Murihiku 2008.

24 NPSFM Appendix 2 p 39-40.

25 For at 50% of time the estimated risk of infection is less than <1 in 1000 exposures.

26 McBride and Soller 2017; Ministry for the Environment 2017.

81. Of the 40 sites that had attribute states assessed the majority (34 sites, 85%) were not suitable for swimming (bands D and E). Only 15% were in the swimmable bands, A and B. There were no sites in the C band. All the monitored FMUs had sites with D and E grades (Table 3, **Appendix E**)

82. Five-year medians for 56 sites are available on the LAWA website. When these medians are compared to the median required for the 'swimmable' bands (A, B, C), [27] 20 sites (36%) are considered 'swimmable'/safe and 36 sites (64%) could be considered high risk/unsafe for swimming. There are 8 sites that are over 5 times the 'swimmable' median (Table 3, **Appendix E**). Figure 10 (**Appendix E**) shows the magnitude of exceedances across the four FMUs. The monitoring sites near the two freshwater Mātaitai[28] (areas protected and managed for customary fishing) in Southland are nearly 5 and 10 times over the 'swimmable' threshold.

83. The LAWA analysis of the 10-year trends of the 52 sites assessed showed that 20 were improving, 19 were indeterminate, and 13 were (very likely or likely to be) degrading. Figure 14 shows the state (safe vs unsafe) and the proportion of each showing improving, indeterminate, and degrading trends. For the 'safe' sites, 47% show improvement, 29% degradation, and 24% indeterminate trends (where the trend direction could not be ascertained). For 'unsafe' sites, 43% of sites are indeterminate, 34% show improvement and 23% are degrading further.

84. In summary, this highlights that sites that are in a good condition and poorer condition are both at risk of degradation. It is also important to reiterate that the State of The Environment sites are not designed to reflect sites that may be used for mahinga kai.

(ii) *Toxic algae: Cyanobacteria*

85. Cyanobacteria (or blue-green algae) can bloom in lakes and rivers in the water column (planktonic) and in rivers on the bed (as dense mats/benthic). At times, these algae can create toxins which can be harmful to humans and animals, through either direct skin contact, ingestion or inhalation.

[27] McBride and Soller 2017; Ministry for the Environment 2017 (median ≤130 E. coli per 100 ml).

[28] Mataura River Mātaitai 2005; Waikawa Harbour/Tumu Toka Mātaitai 2008.

86. All the Ngāi Tahu Statutory Acknowledgment Rivers in the Southland region have had one or more sites experience benthic cyanobacteria proliferations on one or more occasion since 2009.[29] This summer there have been toxic algae alerts for the Waiau, Mataura and Waikaia.

87. The concentrations of toxins associated with cyanobacteria in the Oreti and Waikaia Rivers are the highest detected nationally.[30]

88. Planktonic cyanobacteria blooms have occurred in Lake Waituna in 2018 and 2014, and The Reservoir in 2017.

Te Hauora o te Taiao (the health of the environment)

89. To be able to practice mahinga kai requires ecosystem health to support mahinga kai species in sufficient health and numbers (Figure 4).

(i) *Macroinvertebrate Community Index*

90. Macroinvertebrates play an important role for stream, river and ecosystem health. More specifically, they play an important role in processing aquatic and terrestrial plant matter, and are an important food source for mahinga kai/taonga species.

91. The MCI is a tool used to assess water quality, as different taxa have different tolerances to environmental stress. It is important to note that MCI has two versions, one designed specifically for hard-bottomed streams and another for soft-bottomed streams. These difference account for natural variation of taxa within these contrasting habitats. The MCI can only be used for wadeable streams. As such it does not represent the health of lakes, wetlands, estuaries, groundwater or large (non-wadeable) rivers.

92. Hodson and Akbaripasand 2016 considered the state of the MCI in Southland for the period between 2010 to 2014. Out of 81 sites, 18% had an Excellent grade and 9% had a Poor grade. The rest of the sites shared equally good and

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29 McAllister et al. 2016; Mr Hodson evidence.

30 McAllister et al. 2016.

fair grades (73%). The sites with the Poor grades were in the Oreti (5 sites) and Mataura (2 sites) FMUs.[31]

93. The same study examined the compliance of the Regional Water Plan (**RWP**) MCI standards for different waterbody management units. The RWP standards were not met at 19 out of 81 sites (23%). The sites that failed were in the Mataura, Oreti and Aparima FMUs. Of the 72 sites that had sufficient data for trend analysis over the 1997-2014, 28% of sites had declining trends, 71% indeterminate trends and no sites had improving trends. The declining trends are spread across the four monitored FMUs.[32]

94. LAWA 2018 provides median state data for MCI 2003-2017, and 10-year trend analysis for 2008 to 2017. Out of 36 sites that were assessed, 14% had an Excellent grade, 11% Poor, 27% Fair and 48% a Good grade. Of these sites, 28% were improving (very likely and likely), 39% were indeterminate and 33% were degrading (very likely and likely).

95. The NPSFM 2017 update incorporated a requirement for regional councils to use the MCI as part of their monitoring of progress and achievement of freshwater objectives and values.[33] Methods are also required to seek improvements for MCI scores below 80 and to halt declining trends. In Southland almost a third of sites are showing declining trends and seven sites have scores below 80.

(ii) *Toxicity*

96. At high concentrations, nitrate and ammonia become toxic to aquatic animals (and humans).

97. Although Southland currently meets the toxicity bottom-line for nitrate and ammonia concentrations, there are likely to be some growth effects on sensitive aquatic species in Bands B and C.

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31 Mr Hodson's evidence for Environment Southland Appendix 2, a.

32 Hodson and Akbaripasand 2016, Mr Hodson's evidence for Environment Southland Appendix 2, b and c.

33 Policy CB1, CB3.

98. For nitrate, all sites in the Waiau FMU are within the A attribute state band. However, within the other three FMUs there is a range of sites with attribute state bands of A, B and C (Tables 4a, 5a **Appendix E**).

99. The Environment Southland Water Quality Report results show the poorest attribute state band for Ammonia toxicity is C. The band C sites are exclusively in the Mataura FMU. There are sites within band B spread across each FMU. The majority of sites (60%) are within the A band. (Table 4a, **Appendix E**)

Te Hauora o te Wai (the health of the waterbody)

(i) *Rivers – Nutrients- trophic level*

100. For nitrate and total nitrogen, 69% and 75% of the sites respectively do not comply with the ANZECC trigger value.[34] 10% of sites are over five times the trigger value for nitrogen.

101. For nitrate, Environment Southland analysis reports that nearly 50% of sites have deteriorated over the 17 year period from 2000 to 2016.[35] The LAWA 10 year analysis (2008 to 2017) reports that 27% sites are degrading (very likely and likely), 54% are improving (very likely and likely) and 19% are indeterminate.

102. Dissolved Reactive Phosphorus median concentrations exceeded their respective ANZECC guidelines at 49% of the sites.[36] The Environment Southland 17 year trend analysis showed that 55% of sites were improving.

(ii) *Wetlands*

103. As an important source of mahinga kai, wetlands are an important cultural resource to Ngāi Tahu ki Murihiku.[37] Comparing historic data (circa 1840) and 2010 data, 90% of wetlands have been lost within Southland (excluding the public conservation lands of Fiordland National Park and Stewart Island/Rakiura).[38]

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34 Hodson et al. 2017.

35 Hodson et al. 2017.

36 Hodson et al. 2017.

37 Ngāi Tahu ki Murihiku 2008.

38 Fitzgerald et al. 2010; Clarkson et al. 2011.

104. In a recent study, the amount of wetland loss in the more developed areas of Southland (i.e. excluding Rakiura and Fiordland) was estimated to be 10.5% (or 3,425 hectares of wetland) (1990-2012). A further 3,943 ha was considered at risk (due to recent drainage).[39] During the study period, there was an average 157 ha of wetlands lost per year (0.5% per year). [40]

105. A large proportion of the wetland loss (1990-2012) has occurred in the Waituna Lagoon catchment.[41] This area is recognised in statute for its associations and importance to Ngāi Tahu whānui.[42]

106. Environment Southland commissioned a mapping excise of wetlands >0.5 ha in size (excluding public conservation lands), to monitor changes in wetland extent. The mapping results show a loss in wetland extent from 2007 to 2014-15 of 1362 ha which is approximately 7% (in those wetlands mapped).[43] This gives a decline rate of about 1% per year. The loss was concentrated in the lowland areas of Southland.

107. These results cumulatively show that the current protection for wetlands is not strong enough and needs to be strengthened.

(iii) *Lakes*

108. Of the Ngāi Tahu Statutory Acknowledged Lakes in the Southland region, Te Anau and Manapouri, have the best NPSFM ecosystem and human health attribute states (all A) (Table 6, **Appendix E**).[44]

109. Waituna and Uruwera/Lake George are in a poorer state (Table 6, **Appendix E**).

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39 Robertson et al. 2019.

40 Robertson et al. 2019.

41 Robertson et al. 2019; see Evidence of Dr Lloyd on behalf of the Southland Regional Council, Attachment 3.

42 NTCSA 1998 Schedule 73.

43 Ewan 2018.

44 Hodson et al. 2017.

110. In the Mataura FMU, the NOF bottom-line is not met for Total Nitrogen in Lake Vincent, and Chlorophyll-*a* in The Reservoir. [45] Waituna does not meet the NOF bottom-line for Primary Contact or Total Nitrogen (when closed) (Table 6, **Appendix E**).

(iv) *Estuaries*

111. The estuaries are the meeting places of the rivers and coastal environment. As mentioned earlier, numerous mahinga kai species (both freshwater and coastal) have to migrate through estuaries as juveniles and/or return to sea as adults (e.g. inanga, koaro, kokopu, bully, torrentfish, tuna, smelt and black flounder). Some also reside within estuaries (e.g. tuaki/cockles and patiki/flounders). As such, these species require estuarine ecosystems that are in healthy condition.

112. The following whakatauki (proverb) is used in the Ngāi Tahu ki Murihiku Iwi Management Plan. It recognises the connection between estuaries and rivers: [46]

> ***He taura whiri kotahi mai ano te kopunga tai no i te Pü au***
>
> *From the source to the mouth of the river, all things are joined together as one.*

113. All estuaries in the Southland region are included in the Statutory Acknowledgements of Rakiura/Te Ara a Kiwa (Rakiura/Foveaux Strait CMA) (Schedule 104) and Te Mimi o Tu Te Rakiwhanoa (Fiordland CMA) (Schedule 102), as well through their respective River Statutory Acknowledgements.

114. New River Estuary (Oreti FMU) and Jacobs River Estuary (Aparima FMU) are both in a poor state of ecological health.[47]

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[45] Hodson et al. 2017.

[46] Ngāi Tahu ki Murihiku pg 164.

[47] Townsend and Lohrer 2015, Robertson et al. 2017.

115. From 2001 to 2018 New River Estuary has lost 40%of its seagrass[48] and grossly eutrophic areas have increased from 23 ha to 428 ha.[49] Gross eutrophic conditions are likely to kill or displace most estuarine animals and shellfish.

116. From 2003 to 2016 gross eutrophic areas have increased in Jacobs River Estuary from <20 ha to 145 ha.[50]

117. There has been rapid decline in the state of these two culturally important estuaries.[51] The main drivers for the severe decline of New River Estuary and Jacobs River Estuary are nutrient enrichment, and nutrient enrichment in combination with sedimentation, respectively.[52]

118. New River Estuary is at my doorstep and is a place where as a whanau we will take a net and harvest patiki/flounder. High macroalgae cover fouls the net. As we travel to the tītī islands most years via helicopter, we have watched the estuary progressively grow blacker with macro-algae beds over the past decade.

119. Fortrose (Toetoes) Estuary at the mouth of the Mataura River has been described as being in a moderate state of ecological health.[53] Monitoring in 2016 has found the appearance of gross eutrophic areas (8.3 ha) which were not present in preceding monitoring.

120. Parts of Waikawa estuary (covered by mātaitai, nohoanga and a main mahinga kai site for some whānau) are in a moderate state of ecological health, particularly in the upper sections, with the central and lower sections in a good state. Overall, the estuary is considered to be in good health, although concern was stated in Townsend and Lohrer (2015) over a possible expansion of macro-algae, with management of nutrient input deemed necessary to prevent threshold change. The formation of a small gross eutrophic area (0.7 ha) was discovered in 2016.[54]

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48 Robertson et al. 2017.

49 Stevens 2018.

50 Robertson et al. 2017

51 Townsend and Lohrer 2015.

52 Townsend and Lohrer 2015.

53 Townsend and Lohrer 2015.

54 Robertson et al. 2017.

Does the state of the environment meet Te Mana o te Wai?

121. In my opinion, the evidence above demonstrates that Te Mana o te Wai (Te Hauora o te Tangata; Te Hauora o te Taiao and Te Hauora o te Wai) is not supported within the Mataura, Oreti, Aparima and Waiau FMUs (Tables 3, 4a, 4b, 5a, 5b **Appendix E**).

122. The long-term, cumulative and contemporary impacts of poor water quality on ecosystem health and, in turn, on mahinga kai mean that the current state of our waterways does not meet the expectations of our generation of Ngāi Tahu whānui (refer to Mr Skerrett's evidence at paragraphs 96-98).

123. To consider and recognise Te Mana o te Wai in the proposed Southland Water and Land Plan (**pSWLP**), as required by the NPSFM, requires putting the health of the Wai as the highest priority (refer to Ms Cain's evidence at paragraph 85). To do so requires applying a precautionary approach towards the health of the environment, people and waterbody first, before considering consumptive uses. This requires applying such tools as physiographic zones, to enable the management of the land and water together, and users to prove that they will not further degrade the currently impacted freshwater environment.

124. The linkage between needing to manage the whenua and wai together is reflected in the following whakatauki:

> *Toitū te marae o Tane, toitū te marae o Tangaroa, toitū te tangata*
> *Protect and strengthen the realms of the land and sea and they will protect and strengthen the people.*

USE OF CULTURAL INDICATORS AND TOOLS AVAILABLE

125. Mr Skerrett and Ms Cain's evidence highlights the interconnective nature of Ngāi Tahu with the environment.

126. Ngāi Tahu have developed a specific knowledge base around the ecosystems, species and resources within their respective takiwā from sustained cultural use over a long period of time. This mātauranga (knowledge) informs and guides their management of environmental resources within their cultural landscape.

127. The inclusion of tangata whenua values in freshwater management and decision making is required by numerous pieces of legislation and policy including the Resource Management Act 1991 and the NPSFM 2017. This requires tools and monitoring that can facilitate iwi involvement in resource management processes and decisions.

128. Ngāi Tahu perspectives of resource management are likely to differ from those of non-Māori. Therefore, to assess and monitor cultural values and Te Mana o te Wai requires the use of indicators relevant to Ngāi Tahu. Such indicators do differ from those used in the science conducted by regional councils.[55]

129. Ngāi Tahu indicators of health can include those that assess; whether the characteristics reflected in the traditional name are still present, the qualities of the river and if they provide for the cultural uses known of the area, the sound and smell of the water, flow regime, shape of the river, species present and condition and safety to access and use the site, and seasonality (refer to Ms Cain's evidence at paragraph 45).

130. Cultural monitoring tools assist to facilitate and enable iwi practitioners to assess their cultural values and to participate in freshwater management and decision-making.

131. Initial work to create cultural monitoring tools began in the 2000s with the development of the Cultural Health Index (**CHI**) for streams. The CHI development was led by Dr Gail Tipa (Ngāi Tahu) and Ms Laurel Teirney and was funded as part of the Ministry for the Environment Environmental Performance Indicators Programme.

132. The CHI enables iwi practitioners to monitor: the significance of the site to whanau and whether whanau desire to return to that site in its current condition; the status of mahinga kai values, and cultural health of the stream.[56] This tool underwent rigorous design, validation and testing, with the guidance of Professor Colin Townsend to ensure that it was able to be used in other Takiwā. This tool has been used and adapted for use within different regions across New Zealand, including in Southland. [57]

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[55] Tipa and Terirney 2006a.

[56] Tipa and Teirney 2003, 2006a, 2006b.

[57] Rainforth and Harmswoth 2019.

133. Numerous other cultural monitoring/assessment tools have also been developed for other ecosystem types by different iwi/hapū.[58]

134. The use of cultural monitoring tools that incorporate Ngāi Tahu indicators of health are not new in Southland. Such tools have been applied and used in freshwater management for over a decade.

135. The State of the Takiwā is an environmental monitoring approach that attempts to integrate Māori cultural values and western science measures in the gathering and reporting of information about the health of the environment.[59] This approach incorporates the CHI and monitoring against Ngāi Tahu indicators of health.

136. The first ever State of the Takiwā study was undertaken in the Waiau River catchment in 2005.[60] The Mataura/Waikawa River study was undertaken in 2008.[61] During both these assessments Environment Southland staff were involved in supporting the monitoring.

137. The CHI component of these State of the Takiwa studies were incorporated into the State of the Environment 2010 reporting.[62]

138. Kaitiaki of the Waikawa River have undertaken cultural monitoring of kanakana since 2009. Monitoring of the number of kanakana counts at customary gathering areas lead to a Nga Pae o te Maramatanga New Zealand's Māori Centre of Research Excellence (**CoRE**) research project to support this monitoring by using an acoustic camera (**DIDSON**) to correlate counts on the falls to numbers going past.[63] Environment Southland provided science support to this research.

139. When Lamprey Reddening Syndrome (unexplained haemorrhaging) started showing up in kanakana adults coming back into Southland Rivers, customary

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58 Rainforth and Harmswoth 2019.

59 Pauling 2005.

60 Pauling 2005.

61 Pauling 2008.

62 Environment Southland and Te Ao Marama Inc 2011.

63 Kitson et al. 2012.

harvesting was the only method that could monitor the severity and spatial extent of this issue.[64] This highlights that in some cases cultural monitoring may at times be the most effective tool to examine certain issues.

140. The Murihiku-based case study of Ngā Kete o te Wānanga: Mātauranga Maori, Science and Freshwater Management' research programme is developing a Murihiku Cultural Water Classification System. This classification will be based on the qualities of water that are required to support a range of cultural uses. As such, this research will elucidate cultural baselines and thresholds that are based on Ngāi Tahu ki Murihiku values and uses of water. The research includes information derived from cultural and science monitoring of streams (including the CHI).[65]

THE EFFECTS OF HYDRO-ELECTRIC DEVELOPMENTS

141. Hydroelectric dams and operations can have significant impacts on Te Mana o te Wai. They can restrict movements of diadromous fish, which can generally result in their reduction or loss from habitats above obstructions. This is because the construction and operations can create artificial lentic (still water) ecosystems that exotic species can successively exploit.[66] Further, larger migrant eels can be killed passing through turbines.[67]

142. Large dams change the downstream flow regimes, which can alter the habitats and connection of habitats for mahinga kai species. Changes in flow regimes can impact the river, river mouth and coastal morphology, and also provide better substrate for periphyton. [68]

143. Cultural impacts have been noted in two reports around the operations and altering the consent conditions for the Manapouri Power Scheme.

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64 Williams et al. 2017.

65 NKoTW team. 2016, Kitson et al. 2018.

66 Beentjes et al. 2005, Jellyman and Harding 2012, Williams et al. 2017.

67 Beentjes et al. 2005, Williams et al. 2017.

68 Young et al. 2004.

144. These reports document impacts that included: [69]

(a) Wahi ingoa/place names: The Waiau River was named for its turbulent, swirling waters and its great volume of water, which has been greatly altered;

(b) Mauri: "*For tangata whenua, the Waiau River is not a healthy river*";[70].

(c) Kaitiakitanga: in particular the inability to help protect the river;

(d) Awa/Nga wai: With the loss of the water to the Waiau river and the impacts of this to the river ecology and ability to cleanse itself;

(e) Mahinga kai: Impacts on mahinga kai species due to passage issues and changes in river and lake levels; and

(f) Cumulative effects: the health and cumulative effects on the Waiau River.

CONCLUSION

145. This evidence does not contradict that provided for Environment Southland on state and trends of water quality and ecosystem health in Southland waters.

146. There are exceedances of a number of parameters at an FMU level, including human health and ecosystem health (nutrients) in all. In all FMUs except the Waiau there are sites where there would be impacts on up to 20% of aquatic species from nitrate toxicity (band C), and in the Mataura FMU impact on 20% from ammonia toxicity (band C).

147. The lowland Lakes in the Mataura FMU have attributes below the bottom-line for ecosystem health. This includes Waituna Lagoon which is recognised as culturally and ecologically significant.

148. The estuaries within the Oreti and Aparima FMU are in poor health and gross eutrophic zones have expanded rapidly. Toetoes (Fortrose) estuary in the Mataura FMU is heading on a similar course.

149. Wetlands across the region are continuing to be lost due to drainage.

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69 Corry and Puentener 1993, TAMI 2008.

70 Corry and Puentener 1993.

150. Poor environmental state impacts on mahinga kai and cultural health and well-being.

151. When these state and trend results are considered with the cumulative effects on ecosystem health, indigenous species, mahinga kai and Te Mana o te Wai, then in terms of NPSFM Objectives, there are a number that are not being met at an FMU level and will continue not to be met without significant improvements. These are:

Objective A1 to safeguard:

(i) The life supporting capacity, ecosystem processes and indigenous species including their associated ecosystems, of freshwater

(ii) The health of people and communities, as affected by contact by fresh water;

Objective A2: The overall quality of fresh water within a freshwater management unit is maintained or improved while:

(a) protecting the significant values of outstanding freshwater bodies;

(b) protecting the significant values of wetlands; and

(c) improving the quality of fresh water in water bodies that have been degraded by human activities to the point of being over-allocated

Dr Jane Catherine Kitson
15 February 2019

Appendix A

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Appendix B

Figures

Figure 1: Statutory Recognised Ngāi Tahu sites in each Freshwater Management Unit and Environment Southland SOE monitoring sites: a) Mataura

Figure 1: Statutory Recognised Ngāi Tahu sites in each Freshwater Management Unit and Environment Southland SOE monitoring sites: b) Oreti

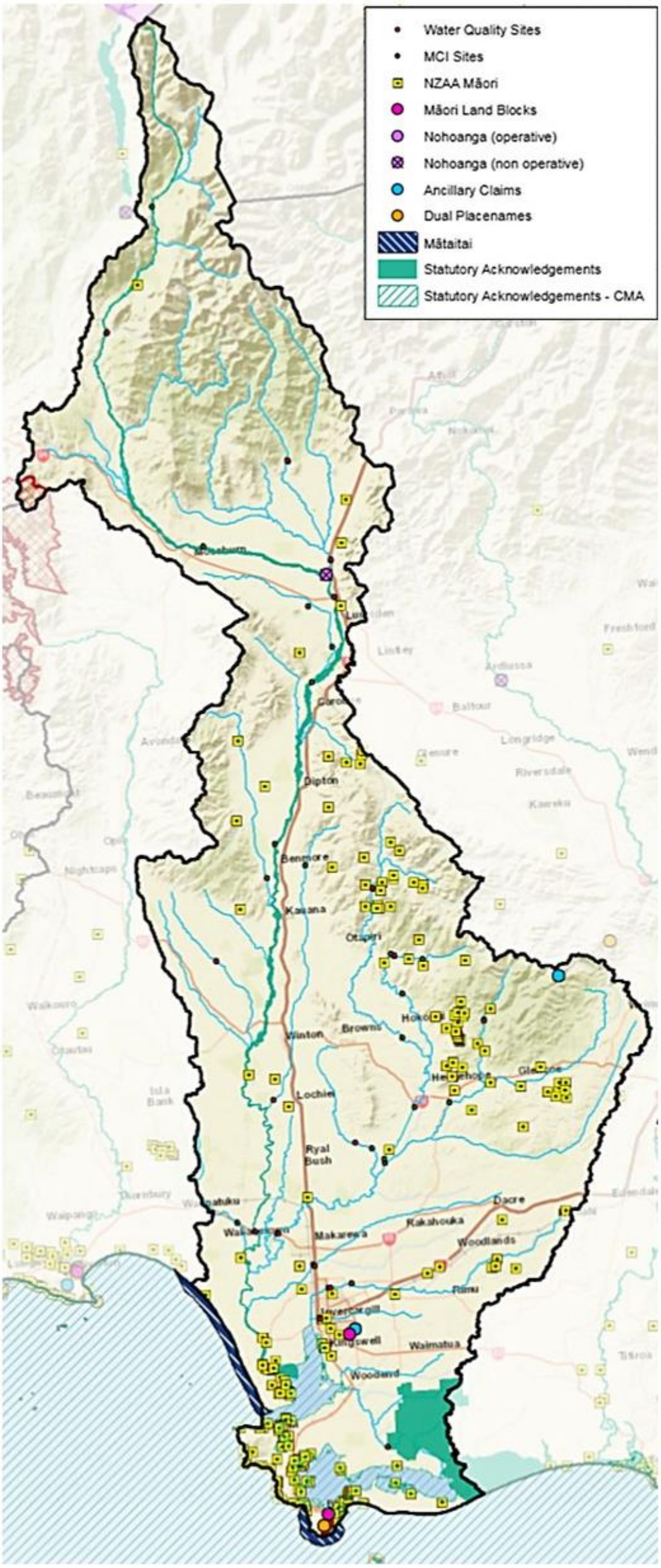


Figure 1: Statutory Recognised Ngāi Tahu sites in each Freshwater Management Unit and Environment Southland SOE monitoring sites: c) Aparima

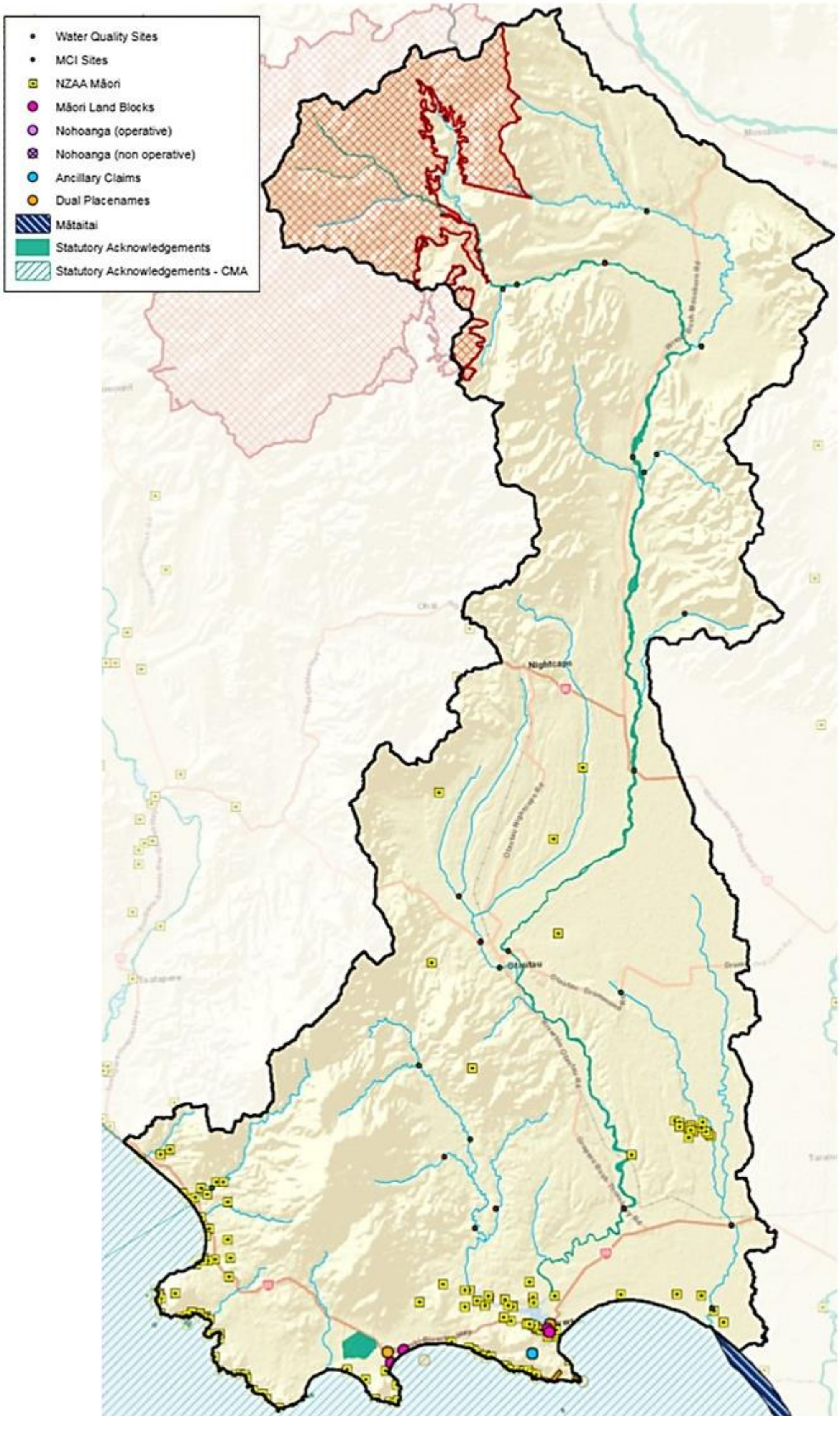


Figure 1: Statutory Recognised Ngāi Tahu sites in each Freshwater Management Unit and Environment Southland SOE monitoring sites: d) Waiau

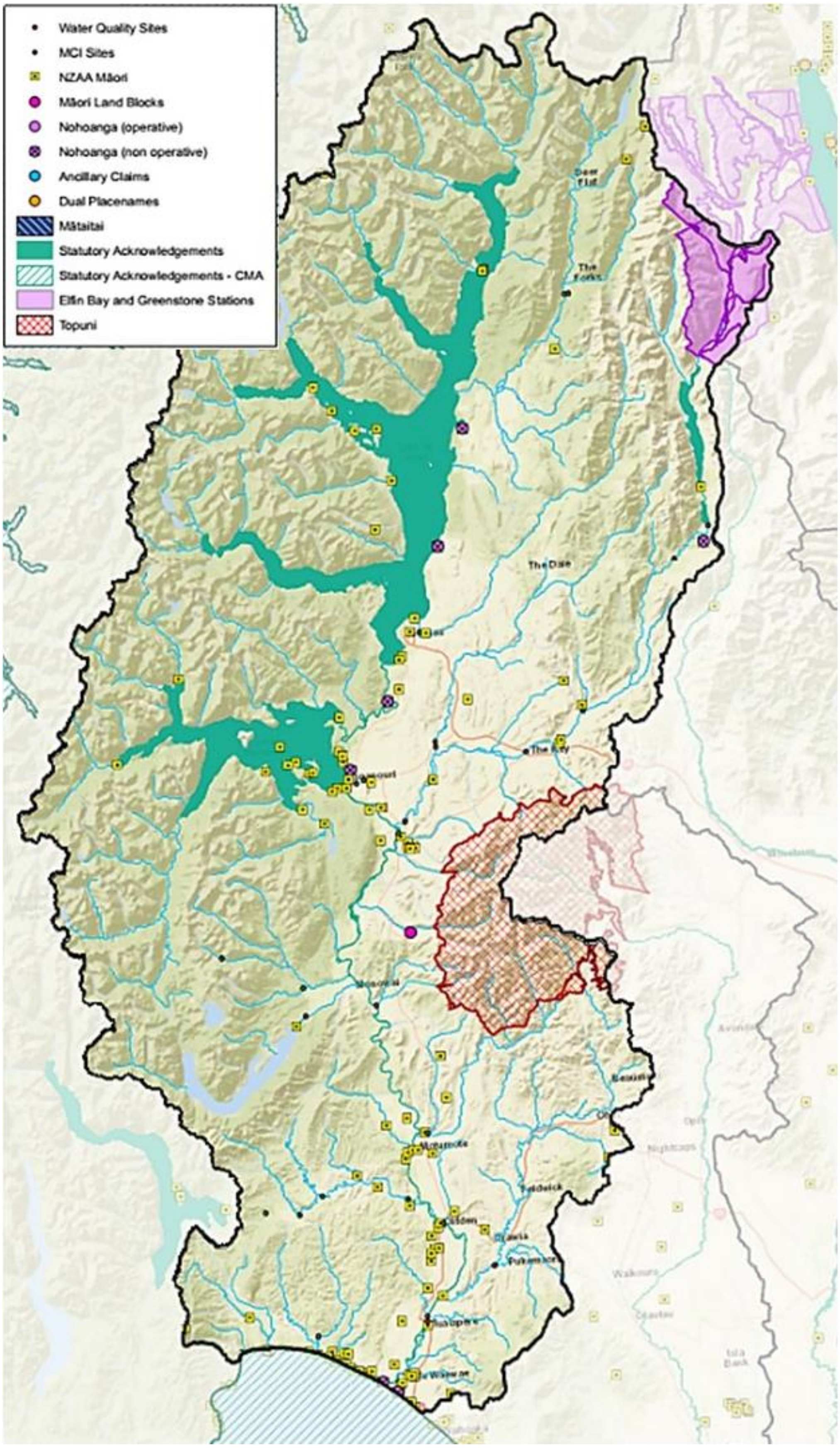


Figure 2: Attributes for mahinga kai/taonga species

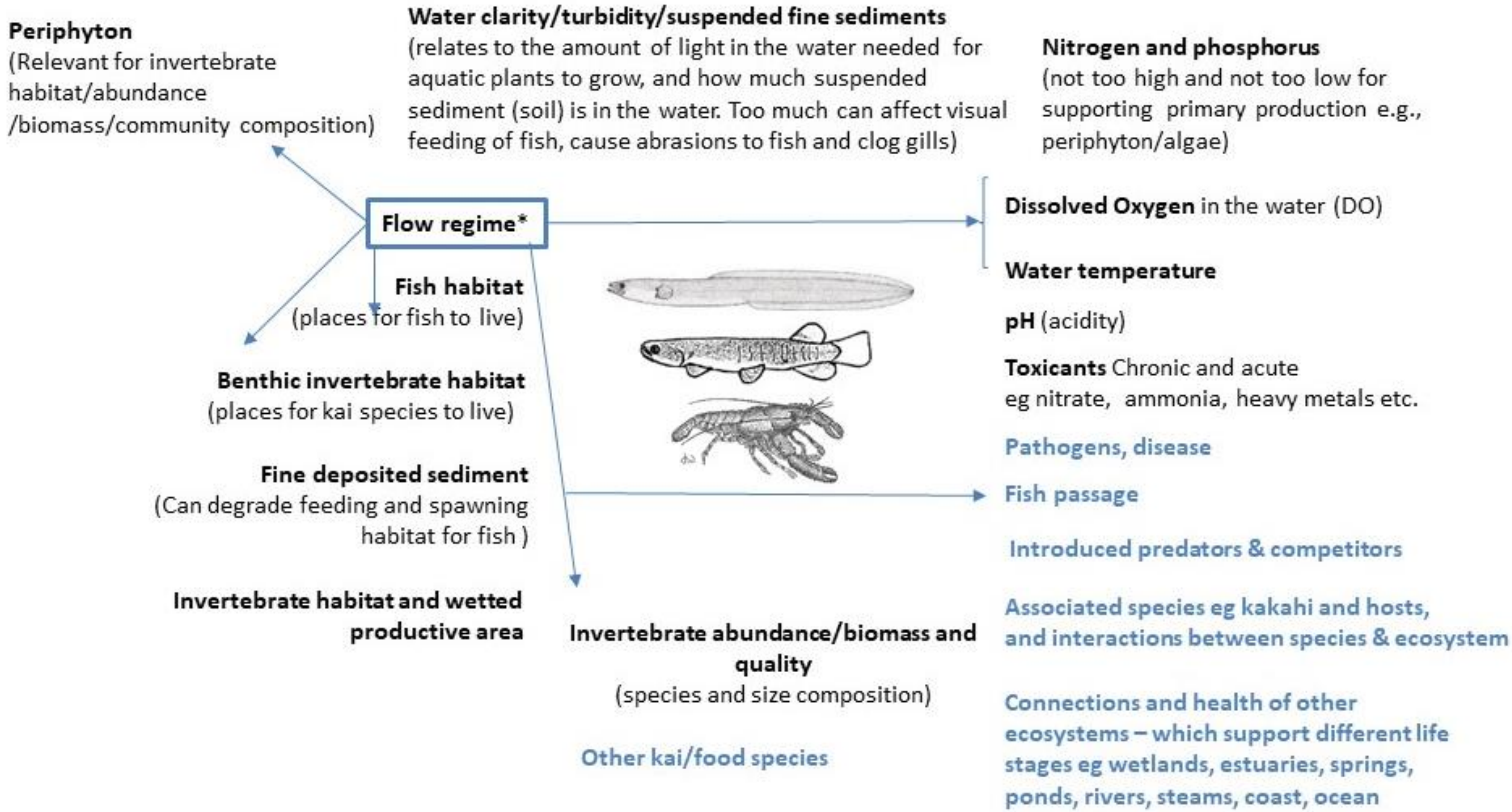


Figure 3: Attributes for mahinga kai activity

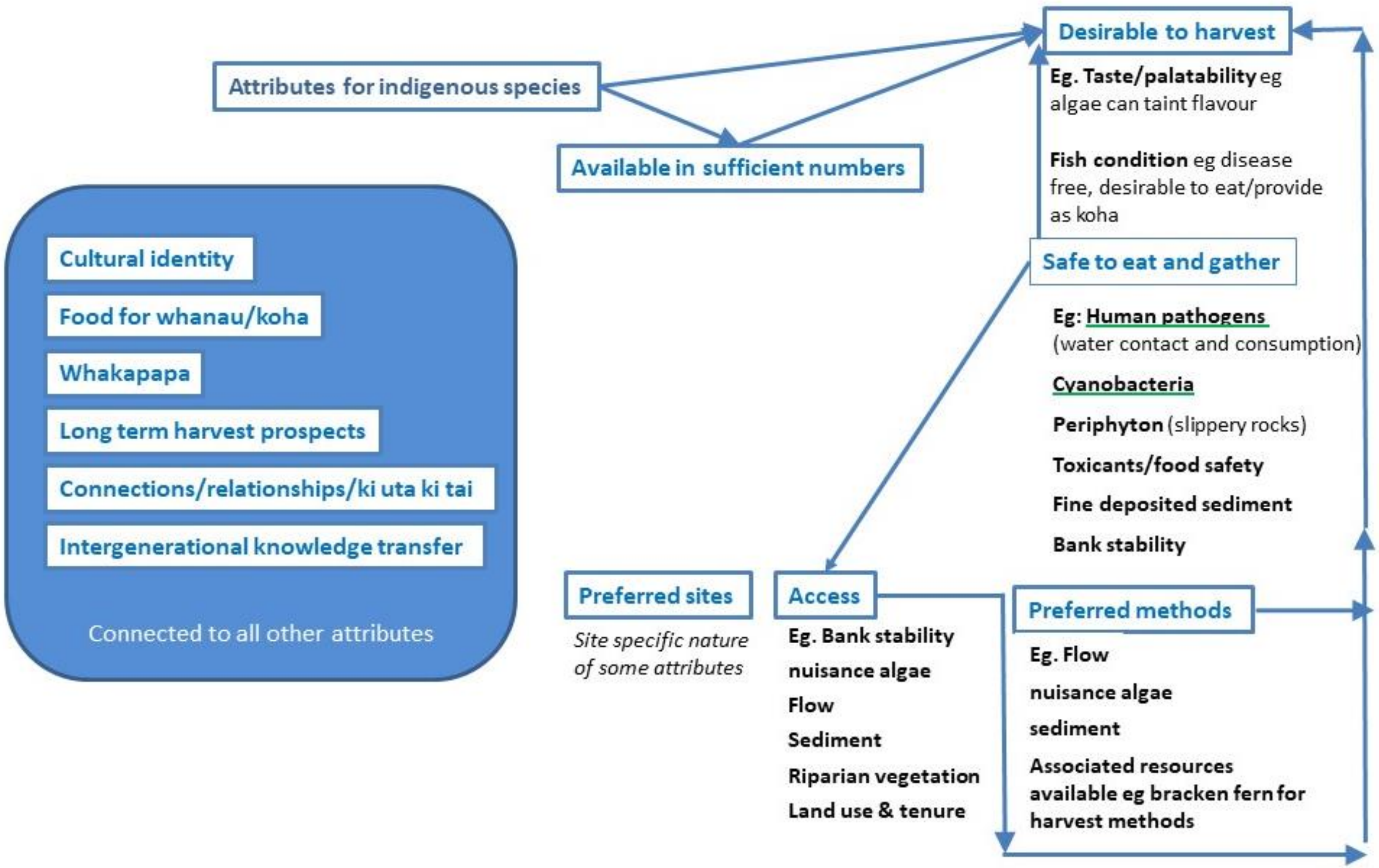


Figure 4: Example of a Freshwater Food web and interconnections between species (Adapted from Young 2007)

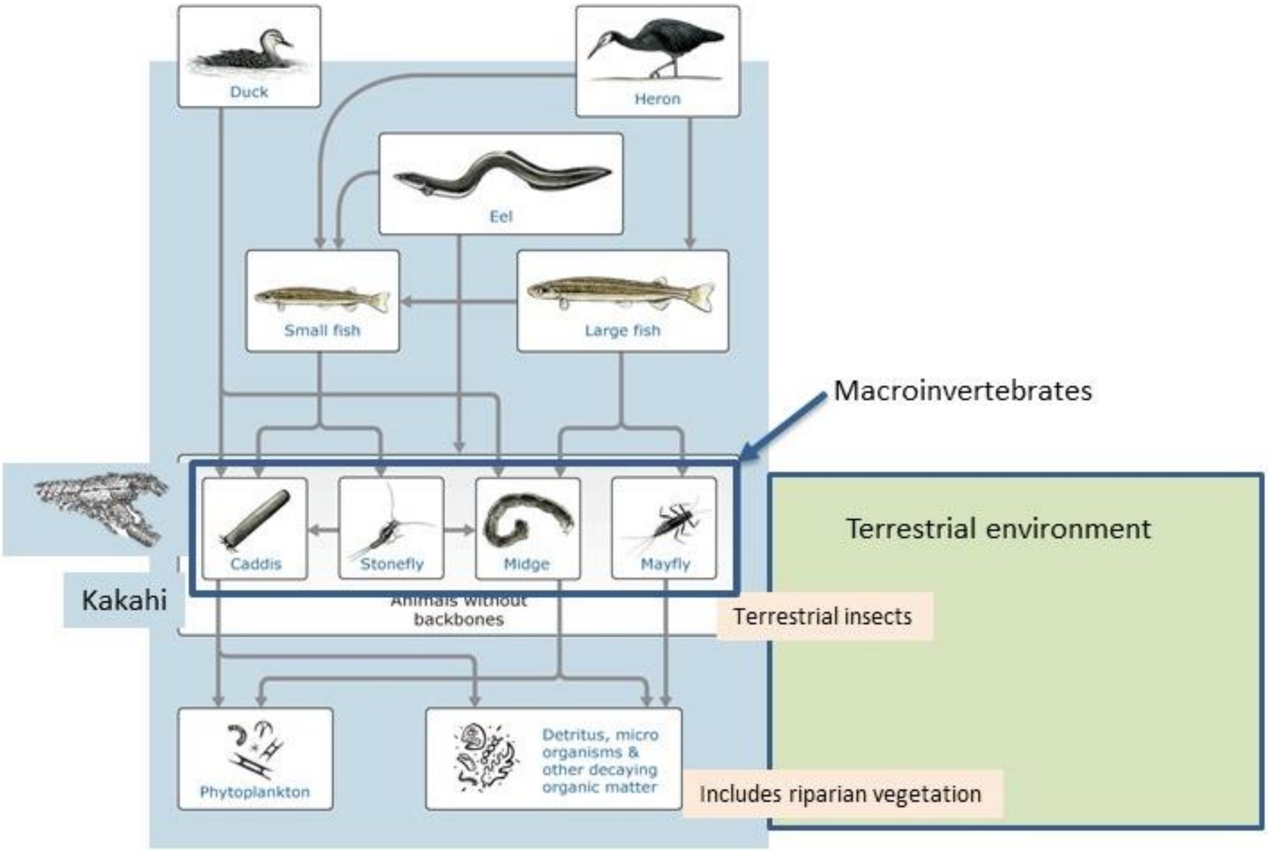


Figure 5: The life-cycle of Tuna/eels (catadromous fish: migrate from freshwater to the ocean to spawn)

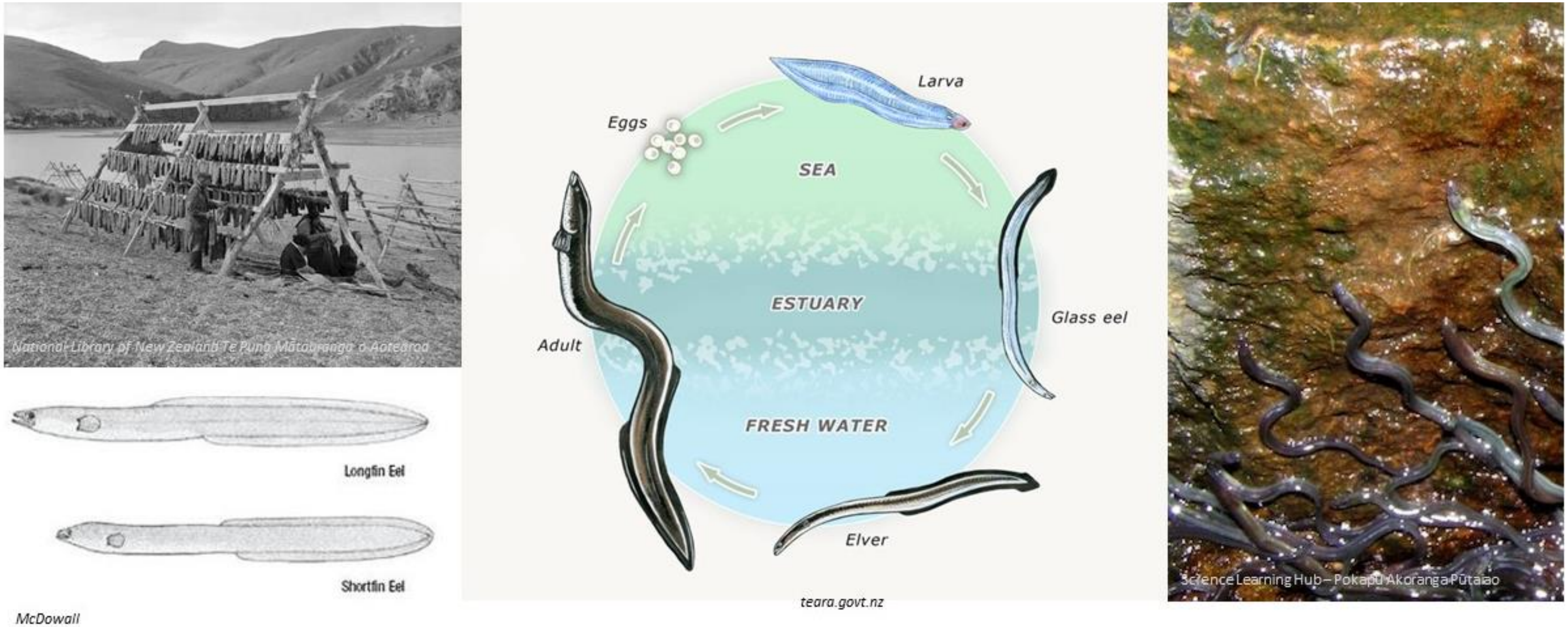


Figure 6: The life-cycle of: Kanakana/NZ Lamprey (anadromous fish: migrates from the sea into freshwater to spawn) (Adapted from Kitson *et al.* 2011)

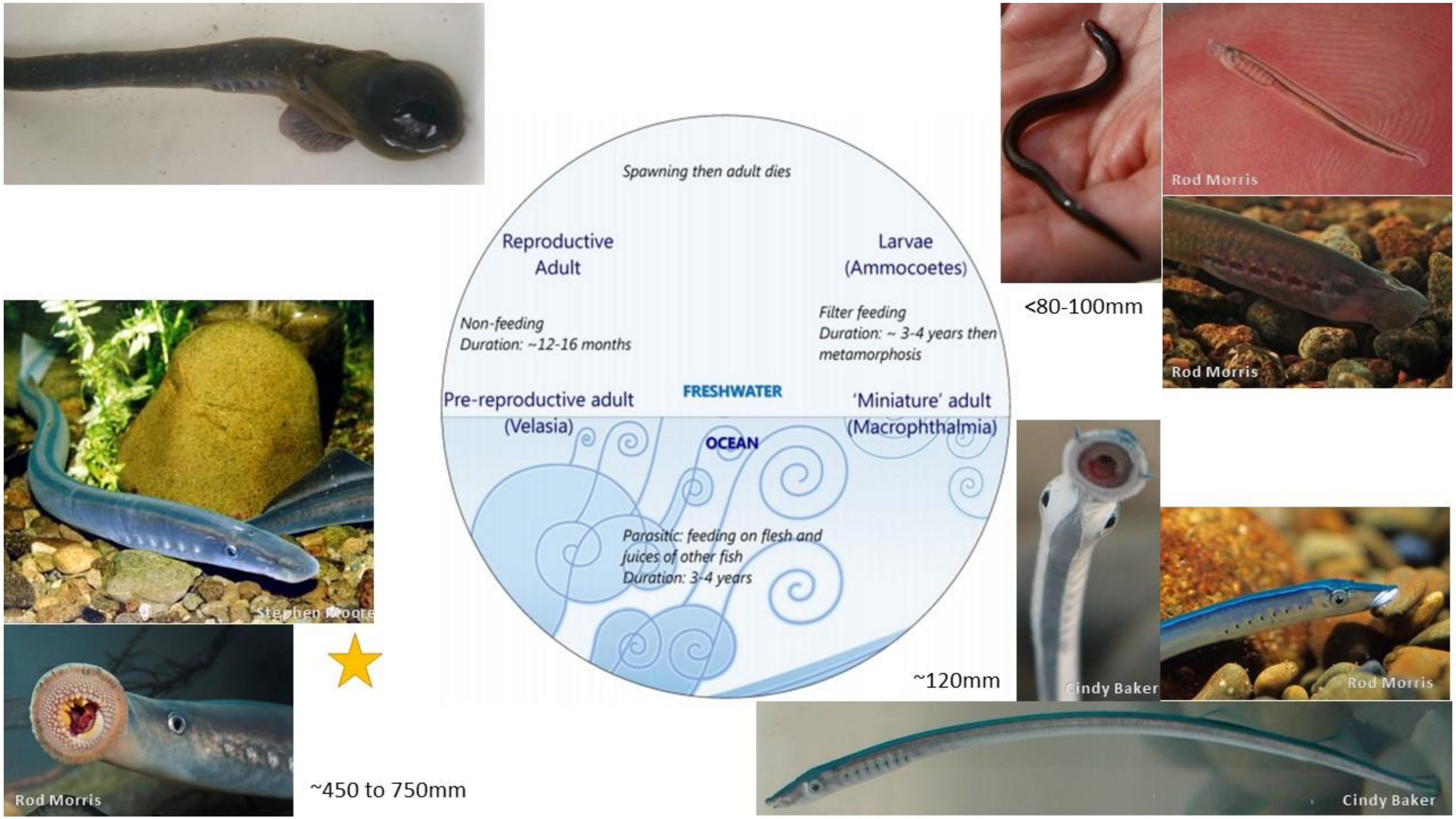
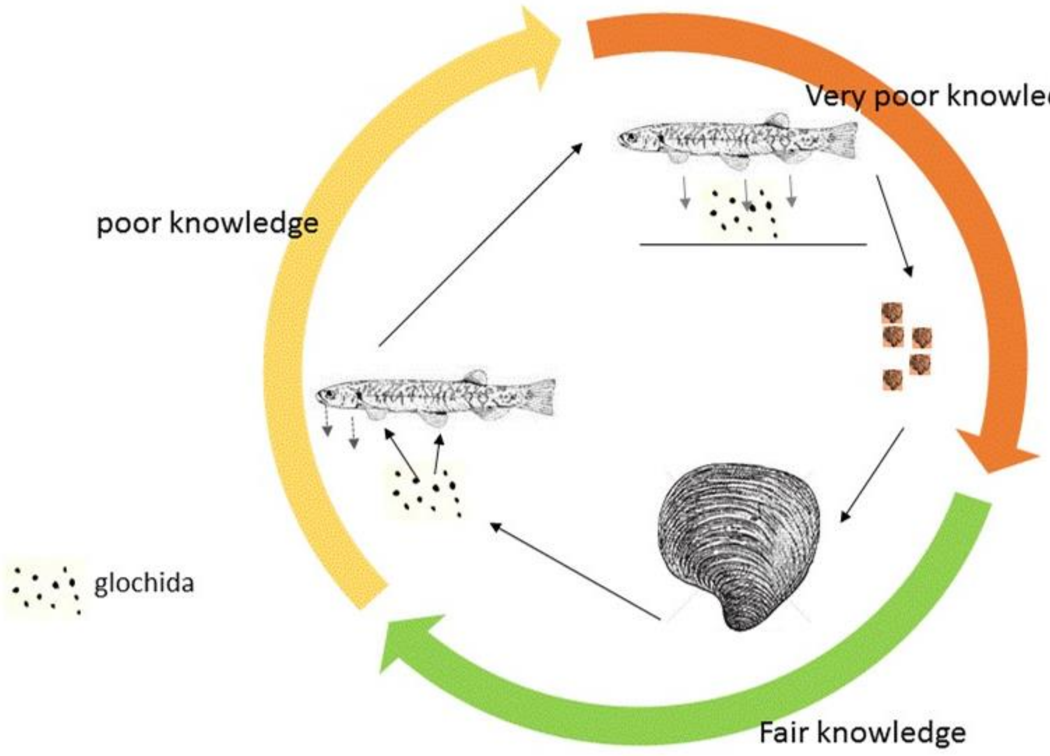


Figure 7: The life-cycle of Waikakahi/freshwater mussels (has parasitic larvae that needs other mahinga kai species to act as hosts)



Current knowledge status of the lifecycle of freshwater mussel (adapted from Phillips 2007)

Figure 8: Indigenous Freshwater Fish found in Southland with the species that use estuaries as habitat circled (Adapted from ES and TAMI 2011)

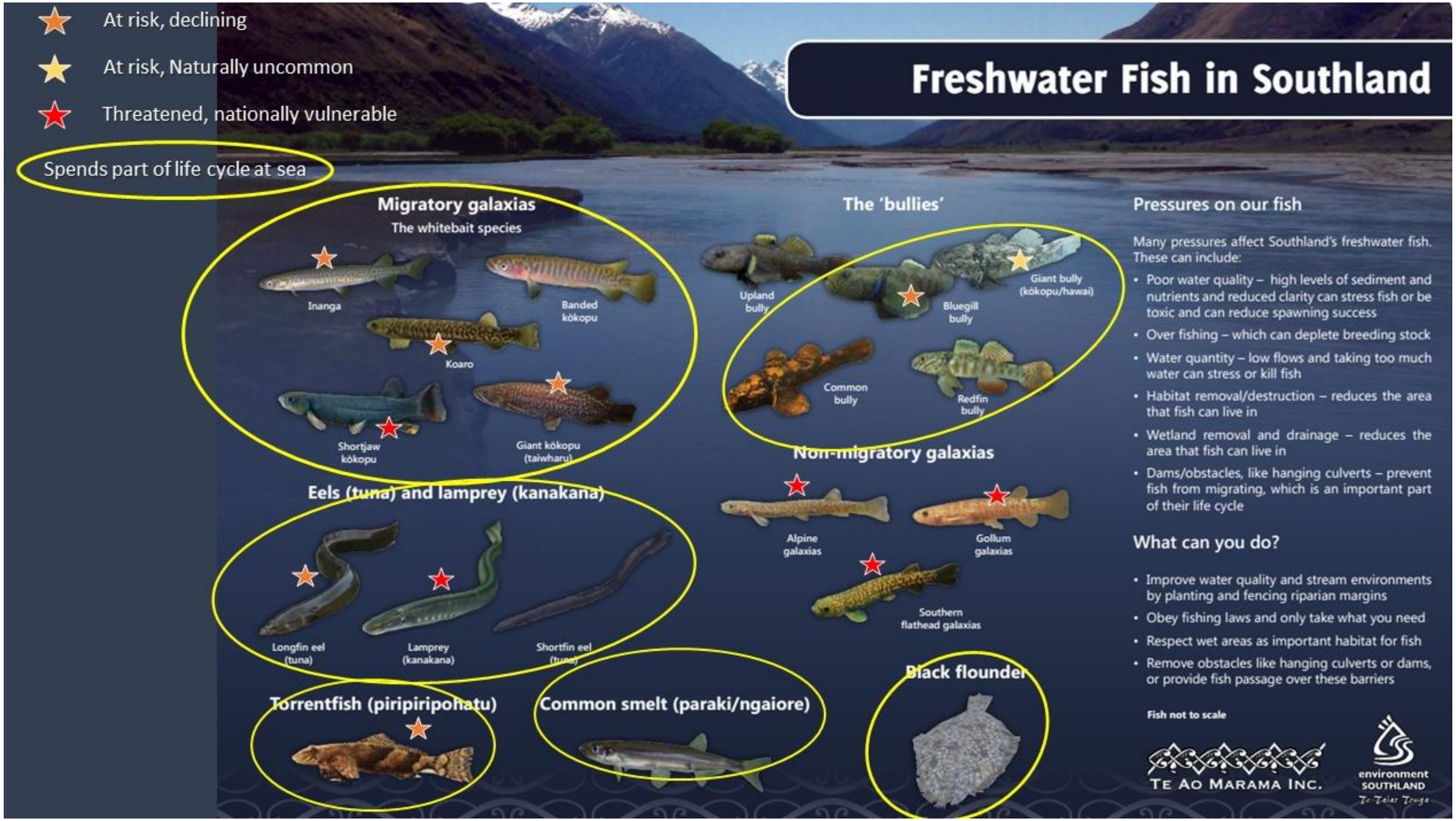
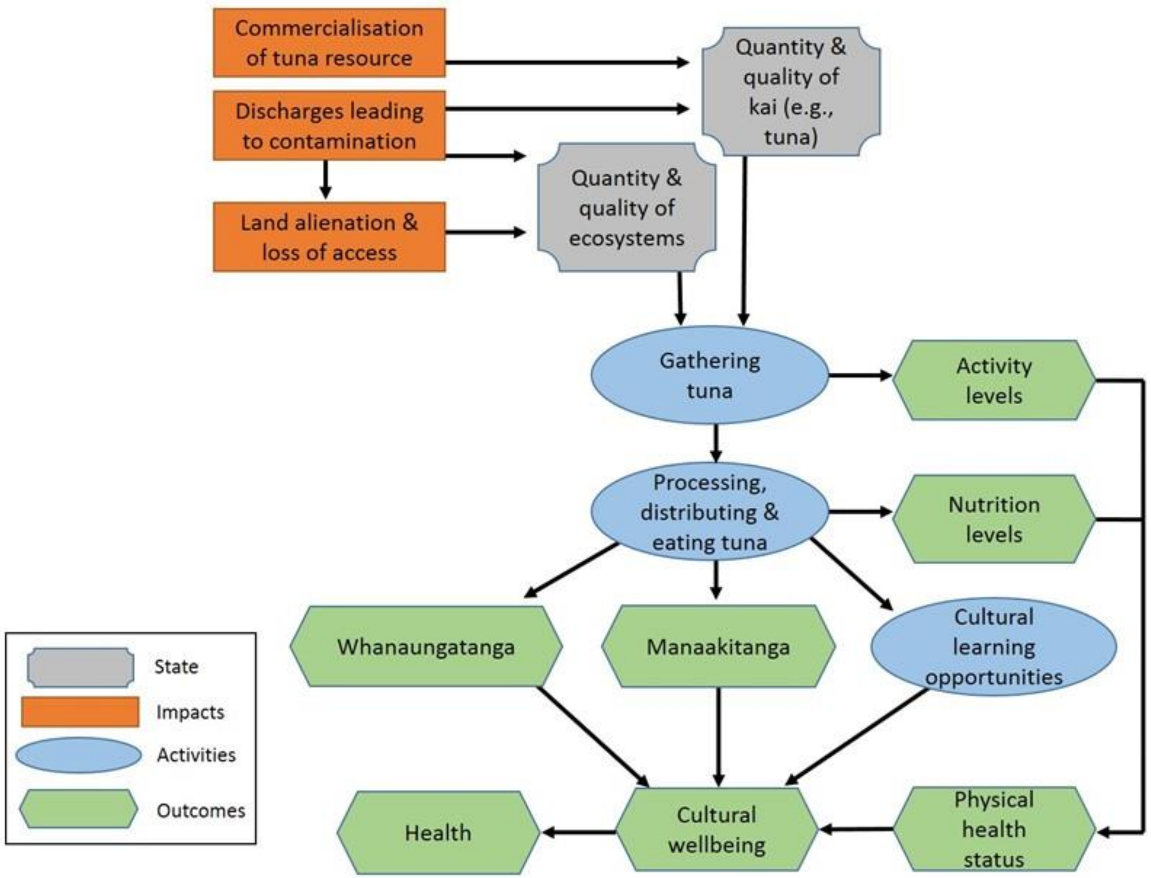


Figure 9: An illustration of the impacts of environmental change on mahinga kai and cultural wellbeing (Tipa 2011, adapted from Donatuto 2008; reproduced in Tipa et al. 2017).



Appendix C

Table 1: Ecological importance of some culturally important mahinga kai specie

Ngāi Tahu name	Common and Scientific Name	Ecological importance
Tuna	Longfin eel and Shortfin eel (*Anguilla dieffenbachii*, *Anguilla australis*)	• Undertake mass migrations between the Pacific Ocean and freshwaters (as juveniles) and freshwater and the Pacific Ocean (as reproductively mature adults); • Eels are the most common freshwater fish species in New Zealand rivers (therefore are a dominant part of stream fish biomass, have a widespread distribution); • Adult eels are apex predators, longfin females are often largest and oldest freshwater fish in our freshwaters; • Capable of occupying full range of freshwater habitats; • Longfin females in particular are able to penetrate long distances inland where connectivity of the ecosystem remains intact; • References include McDowall (1990), Chisnall and Hicks (1993), Martin et al (2010)
Īnanga, kōaro, kōkopu	Whitebait - Inanga, kōaro, banded kōkopu, giant kōkopu, and shortjaw kōkopu (*Galaxias maculatus*, *G. brevipinnis*, *G. fasciatus*, *G. argenteus*, and *G. postvectis*).	• Undertakes mass migrations between the sea and freshwaters (as juveniles); • This family of fishes once made up a large biomass of our waterways, including lakes. • This family of fishes occupies a wide variety of habitats. • Provides a food source for aquatic and terrestrial species. • References include Bonnett & Sykes (2002), Baker & Smith (2007), Rowe et al. (2002), Department of Conservation (2004), McDowall (2010)
Kākahi	New Zealand freshwater mussel (*Echyridella menziesi*)	• Filter feeders that that cycle nutrients and support good water quality. • Can form a large component of the biomass in lake invertebrate communities. • Biological indicators. • References include Walker et al (2001) and James (1985)
Kōura; Keewai	Freshwater crayfish (*Paranephrops. zealandicus*)	• Omnivorous role in stream ecosystem nutrient cycles • Important member of the food chain, especially in lakes • References include Parkyn et al. (2002) and Brown (2009)

Appendix D

Table 2: Parameters used by Environment Southland to monitor states and trends

Attributes	Freshwater body type	Why	Baselines used in this evidence
Nitrate Nitrite Nitrogen (NNN & TON)	Rivers	Toxic to aquatic life Te Hauora o te Taiao	NPS-FM attribute states [71]
	Rivers	Nutrient enrichment (ecosystem health) Te Hauora o te Wai	ANZECC guidelines trigger values [72]
Ammoniacal Nitrogen	Rivers, Lakes	Toxic to aquatic life Te Hauora o te Taiao	NPS-FM attribute states
E. Coli	Rivers, Lakes	Human Health (Swimmability) Te Hauora o te Tangata	NPS-FM attribute states 'swimmable'[73]
Total Nitrogen	Rivers	Nutrient enrichment Te Hauora o te Wai	ANZECC guidelines trigger values
Dissolved Reactive Phosphorous	Rivers	Nutrient enrichment Te Hauora o te Wai	ANZECC guidelines trigger values
Total Phosphorus	Rivers	Nutrient enrichment	ANZECC guidelines trigger values
Macroinvertebrate Community Index (MCI)	Rivers	Stream invertebrates- amount and types Te Hauora o te Taiao	MCI water quality categories[74] Compliance against pSWLP standards NPS-FM Policy CB3
Total nitrogen	Lakes	Trophic State Te Hauora o te Wai	NPS-FM attribute states
Total Phosphorus	Lakes	Trophic State Te Hauora o te Wai	NPS-FM 2014 attribute states
Phytoplankton [chlorophyll-*a*]	Lakes	Trophic state Te Hauora o te Wai	NPS-FM 2014 attribute states

[71] National Policy Statement for Freshwater Management 2014 (2017 update)

[72] Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000

[73] This differs from that presented by Environment Southland. "Swimmable' attribute bands all require a median of ≤ 130 *E.coli* per 100 ml.

[74] Stark and Maxted 2007.

Appendix E

State and Trends

E. Coli and 'Swimmable'

Table 3: *E. Coli* state and trends within each FMU (Data source: LAWA. State 2013-2017, Trend 2008-2017)

FMU	Site	State (NOF)	Median (5 year) n/100 ml	'Swimmable' (median ≤130 *E. coli* per 100 ml)	Magnitude from swimmable	Trend (10 year))
Mataura	Mataura River at Parawa (ES)	D	114.5	Yes	0.9	Very likely degrading
	Waikaia River u/s Piano Flat	NA	20	Yes	0.2	Very likely improving
	Waikaia River at Waikaia[b]	D	200	No	**1.5**	Indeterminate
	Waikaia River at Waipounamu Bridge Road	D	150	No	**1.2**	Very likely degrading
	Longridge Stream at Sandstone	E	305	No	**2.3**	Likely degrading
	North Peak Stream at Waimea Valley Road	E	170	No	**1.3**	Very likely improving
	Sandstone Stream at Kingston Crossing Rd	E	420	No	**3.2**	Very likely degrading
	Waimea Stream at Mandeville	NA	280	No	**2.2**	Indeterminate
	Otamita Stream at Mandeville	D	300	No	**2.3**	Indeterminate
	Mataura River at Gore[b]	E	375	No	**2.9**	Likely degrading
	Waikaka Stream at Gore	E	315	No	**2.4**	Likely improving
	Mataura River 200m d/s Mataura Bridge	NA	1300	No	**10.0**	Indeterminate
	Mimihau Stream Tributary at Venlaw Forest	NA	20	Yes	0.2	NA
	Mimihau Stream at Wyndham	E	385	No	**3.0**	Indeterminate
	Mokoreta River at Wyndham River Road	NA	320	No	**2.5**	Likely improving
	Mataura River at Mataura Island Bridge	E	300	No	**2.3**	Likely degrading
	Oteramika Stream at Seaward Downs	E	700	No	**5.4**	Very likely degrading
	Waikawa River at Progress Valley	E	600	No	**4.6**	Indeterminate
	Tokanui River at Fortrose Otara Road	E	305	No	**2.3**	Indeterminate
	Waikopikopiko Stream at Haldane Curio Bay	D	145	No	**1.1**	Indeterminate
	Waituna Creek at Marshall Road	E	310	No	**2.4**	Indeterminate
	Carran Creek at Waituna Lagoon Road	D	220	No	**1.7**	Indeterminate
ORETI	Oreti River at Three Kings	A	10	Yes	0.1	Indeterminate
	Cromel Stream at Selbie Road	A	20	Yes	0.2	NA
	Irthing Stream at Ellis Road	D	90	Yes	0.7	Indeterminate

FMU	Site	State (NOF)	Median (5 year) n/100 ml	'Swimmable' (median ≤130 *E. coli* per 100 ml)	Magnitude from swimmable	Trend (10 year))
	Oreti River at Lumsden Bridge	B	52	Yes	0.4	Very likely degrading
	Otapiri Stream at Otapiri Gorge	D	415	No	**3.2**	Likely improving
	Bog Burn d/s Hundred Line Road	E	800	No	**6.2**	Indeterminate
	Makarewa River at Lora Gorge Road	NA	460	No	**3.5**	Indeterminate
	Dunsdale Stream at Dunsdale Reserve	NA	140	No	**1.1**	Very likely degrading
	Winton Stream at Lochiel	E	1250	No	**9.6**	Likely improving
	Tussock Creek at Cooper Road	NA	1100	No	**8.5**	Indeterminate
	Makarewa River at Wallacetown	E	335	No	**2.6**	Indeterminate
	Oreti River at Wallacetown[b]	D	130		**1.0**	Likely improving
	Waikiwi Stream at North Road	E	495	No	**3.8**	Likely improving
	Waihopai River u/s Queens Drive	E	330	No	**2.5**	Very likely improving
	Otepuni Creek at Nith Street	E	1700	No	**13.1**	Indeterminate
	Mokotua Stream at Awarua	NA	10	Yes	0.1	Very Likely improving
APARIMA	Waimatuku Stream at Lorneville Riverton	E	450	No	**3.5**	Very Likely improving
	Aparima River at Dunrobin	B	62.5	Yes	0.5	Likely improving
	North Etal Stream u/s Dunrobin Valley Rd	NA	120	Yes	0.9	NA
	Otautau Stream at Waikouro	E	1300	No	**10.0**	Likely improving
	Otautau Stream at Otautau-Tuatapere Rd	E	850	No	**6.5**	Likely improving
	Aparima River at Thornbury[b]	D	130	Yes	1.0	Very likely improving
	Cascade Stream at Pourakino Valley Rd	NA	130	Yes	1.0	Very likely degrading
	Opouriki Stream at Tweedie Road	E	600	No	**4.6**	Very likely improving
	Pourakino River at Traill Road	E	355	No	**2.7**	Very likely degrading
WAIAU	Mararoa River at South Mavora Lake	A	5	Yes	0.0	Likely degrading
	Upukerora River at Te Anau-Milford Road	NA	30	Yes	0.2	Indeterminate
	Whitestone River d/s Manapouri-Hillside	NA	20	Yes	0.2	Very likely improving
	Mararoa River at The Key	NA	35	Yes	0.3	Indeterminate
	Mararoa River at Weir Road	NA	30	Yes	0.2	Very likely improving
	Waiau River at Sunnyside	A	30	Yes	0.2	Likely degrading
	Lill Burn at Lill Burn-Monowai Road	NA	190	No	**1.5**	NA

FMU	Site	State (NOF)	Median (5 year) n/100 ml	'Swimmable' (median ≤130 *E. coli* per 100 ml)	Magnitude from swimmable	Trend (10 year))
	Orauea River at Orawia Pukemaori Rd	E	315	No	**2.4**	Likely improving
	Waiau River at Tuatapere[b]	D	53.7	Yes	0.4	Likely improving

NA = not assessed

[b] = bathing site in RWP

Figure 10: Magnitude of exceedance of the 'swimmable' median of ≤130 E.coli per 100 ml in Southland FMUs (Waiau, Aparima, Oreti and Mataura). Sites that are shaded green are 'swimmable' and all other colours indicate the magnitude of exceedance from the 'swimmable' median. Data source: LAWA: 5 year median 2013-2017.

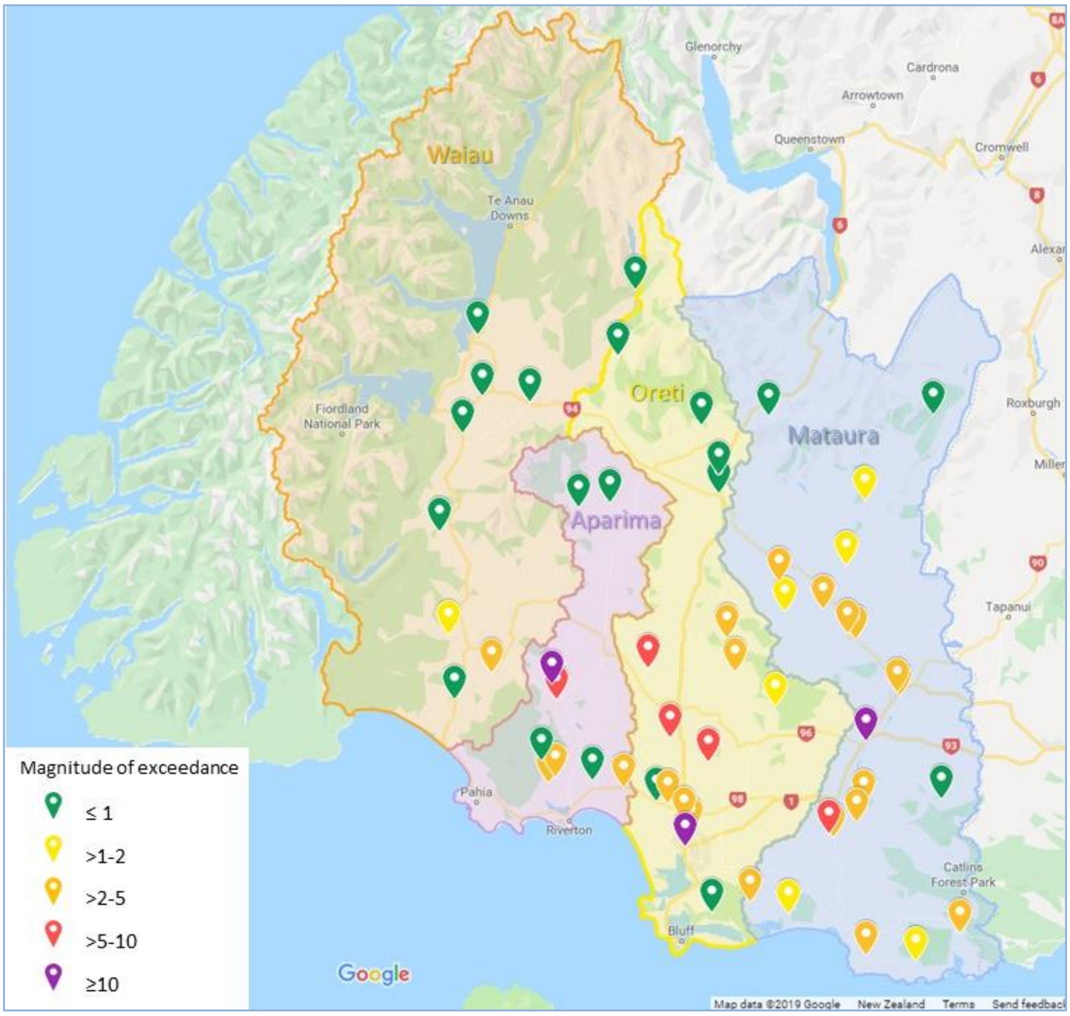


Figure 11: 10-year trends by sites that meet and exceed the median swimmable standard (2008-2017). Data source: LAWA website, accessed late October 2018. Note: 'Very likely' and 'likely' trends have been combined for this figure.

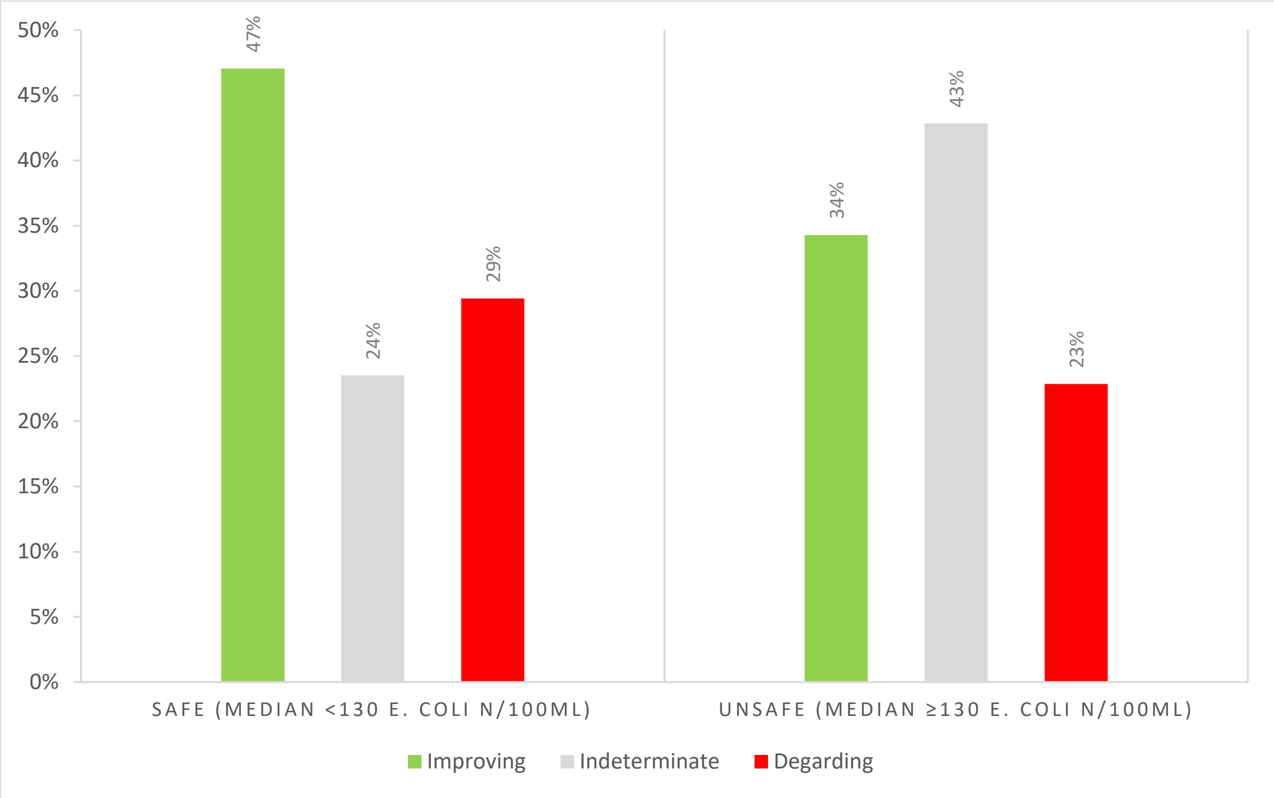


Table 4 a: Toxicity (Nitrate and Ammonia) state and trends by FMU. (Data source: Hodson et al. 2017 data. State 2012-2016, Trends 2000-2016)

FMU	Site	Nitrate (Toxicity)		Ammonia (Toxicity)	
		NOF Attribute state	Trend (17 yr)	NOF Attribute State	Trend (17 yr)
MATAURA	Mataura at Parawa (NIWA)	A	Deterioration	A	Indeterminate
	Mataura River at Parawa (ES)	A	NA	A	NA
	Otamita Stream at Mandeville	B	Deterioration	A	NA
	Mataura River at Gore	A	Deterioration	A	NA
	Waikaka Stream at Gore	B	Indeterminate	B	Improvement
	Mataura River 200m d/s Mataura Bridge	A	Deterioration	B	Indeterminate
	Mimihau Stream Tributary at Venlaw Forest	A	Indeterminate	A	NA
	Mimihau Stream at Wyndham	A	Deterioration	A	NA
	Mokoreta River at Wyndham River Road	B	NA	A	NA
	Mataura River at Mataura Island Bridge	A	NA	A	NA
	Mataura River at Seaward Downs (NIWA)	B	Deterioration	A	Improvement
	Oteramika Stream at Seaward Downs	C	Indeterminate	C	NA
	Waikaia River u/s Piano Flat	A	NA	A	NA
	Waikaia River at Waikaia	A	NA	A	NA
	Waikaia River at Waipounamu Bridge Road	A	Indeterminate	A	NA
	Longridge Stream at Sandstone	C	NA	C	NA
	North Peak Stream at Waimea Valley Road	A	NA	C	NA
	Sandstone Stream at Kingston Crossing Rd	C	NA	C	NA
	Waimea Stream at Mandeville	C	NA	B	NA
	Waikawa River at Progress Valley	A	Indeterminate	A	Improvement
	Waikopikopiko Stream at Haldane Curio Bay	A	NA	A	NA
	Tokanui River at Fortrose Otara Road	B	NA	B	NA
	Waituna Creek at Marshall Road	B	Indeterminate	B	Improvement
	Moffat Creek at Moffat Road	B	NA	B	NA
	Carran Creek at Waituna Lagoon Road	B	NA	B	NA
ORETI	Oreti River at Three Kings	A	Indeterminate	A	NA
	Cromel Stream at Selbie Road	A	NA	A	NA
	Irthing Stream at Ellis Road	B	Deterioration	B	NA
	Oreti River at Lumsden (NIWA)	A	Deterioration	A	Indeterminate
	Oreti River at Lumsden Bridge (ES)	A	NA	A	NA
	Otapiri Stream at Otapiri Gorge	B	Deterioration	A	NA
	Bog Burn d/s Hundred Line Road	B	Deterioration	B	NA
	Makarewa River at Lora Gorge Road	A	Deterioration	A	NA
	Makarewa River at Wallacetown	B	Indeterminate	B	Improvement

FMU	Site	Nitrate (Toxicity)		Ammonia (Toxicity)	
		NOF Attribute state	Trend (17 yr)	NOF Attribute State	Trend (17 yr)
	Oreti River at Riverton HW Br (NIWA)	B	Deterioration	A	Indeterminate
	Oreti River at Wallacetown (ES)	B	NA	A	NA
	Dunsdale Stream at Dunsdale Reserve	A	Indeterminate	A	NA
	Winton Stream at Lochiel	C	Indeterminate	B	Deterioration
	Tussock Creek at Cooper Road	C	Improvement	B	Improvement
	Waikiwi Stream at North Road	C	Deterioration	B	Improvement
	Waihopai River u/s Queens Drive	C	Deterioration	B	Improvement
	Otepuni Creek at Nith Street	B	Indeterminate	B	Indeterminate
	Mokotua Stream at Awarua	A	Improvement	NA	NA
APARIMA	Aparima River at Dunrobin (ES)	A	Indeterminate	A	Indeterminate
	Aparima River at Thornbury	B	Indeterminate	A	NA
	Otautau Stream at Waikouro	B	Indeterminate	B	Improvement
	Otautau Stream at Otautau-Tuatapere Road	B	Indeterminate	B	Indeterminate
	Cascade Stream at Pourakino Valley Road	A	Improvement	A	NA
	Opouriki Stream at Tweedie Road	B	Deterioration	B	NA
	Pourakino River at Traill Road	A	Deterioration	A	NA
	Waimatuku Stream at Lorneville Riverton	C	Indeterminate	B	NA
WAIAU	Mararoa River at South Mavora Lake	A	NA	A	NA
	Mararoa River at Weir Road	A	Deterioration	A	NA
	Mararoa River at The Key	A	Deterioration	A	NA
	Whitestone River d/s Manapouri-Hillside	A	NA	A	NA
	Monowai below Gates (NIWA)	A	Indeterminate	A	Indeterminate
	Waiau River at Sunnyside	A	Deterioration	A	NA
	Waiau at Tuatapere (NIWA)	A	Deterioration	A	Indeterminate
	Waiau River at Tuatapere (ES)	A	NA	A	NA
	Orauea River at Orawia Pukemaori Road	A	NA	B	NA
	Upukerora River at Te Anau-Milford Road	A	Indeterminate	A	NA

Table 4 b: Nutrients (TN, TP, DRP) state and trends by FMU. (Data source: Hodson et al. 2017 data. State 2012-2016, Trends 2000-2016) Note: state medians are shaded green if they fall within the ecosystem health ANZECC guidelines trigger value, and red if they exceed.

FMU	Site	Total Nitrogen			Dissolved Reactive Phosphorous			Total Phosphorus		
		State g/m³	Magnitude of exceedance	Trend (17 yr)	State g/m³	Magnitude of exceedance	Trend (17 yr)	State g/m³	Magnitude of exceedance	Trend (17 yr)
MATAURA	Mataura at Parawa (NIWA)	0.402	**1.4**	Deterioration	0.005	0.56	Indeterminate	0.01	0.4	Indeterminate
MATAURA	Mataura River at Parawa (ES)	0.42	**1.4**	NA	0.005	0.56	NA	0.009	0.3	NA
MATAURA	Otamita Stream at Mandeville	1	**1.6**	Deterioration	0.01	1	Improvement	0.025	0.8	Improvement
MATAURA	Mataura River at Gore	1.095	**3.7**	Deterioration	0.006	0.67	Improvement	0.017	0.7	Indeterminate
MATAURA	Waikaka Stream at Gore	1.35	**2.2**	Indeterminate	0.02	**2.4**	Indeterminate	0.05	**1.7**	Indeterminate
MATAURA	Mataura River 200m d/s Mataura Bridge	1.15	**3.9**	Indeterminate	0.011	**1.2**	Improvement	0.022	0.8	Improvement
MATAURA	Mimihau Stream Tributary at Venlaw	0.27	0.9	Indeterminate	0.011	**1.2**	Improvement	0.015	0.6	Improvement
MATAURA	Mimihau Stream at Wyndham	1.08	**1.8**	Deterioration	0.012	**1.2**	Indeterminate	0.0355	**1.1**	Indeterminate
MATAURA	Mokoreta River at Wyndham River Road	1.38	**2.2**	NA	0.009	0.9	NA	0.026	0.8	NA
MATAURA	Mataura River at Mataura Island Bridge	1.14	**1.8**	NA	0.009	0.9	NA	0.021	0.6	NA
MATAURA	Mataura River at Seaward Downs (NIWA)	1.515	**5.1**	Deterioration	0.01	**1.11**	Improvement	0.03	**1.2**	Improvement
MATAURA	Oteramika Stream at Seaward Downs	2.6	**4.2**	Deterioration	0.032	**3.2**	Indeterminate	0.085	**2.6**	Indeterminate
MATAURA	Waikaia River u/s Piano Flat	0.1	0.34	NA	0.005	0.56	NA	0.008	0.3	NA
MATAURA	Waikaia River at Waikaia	0.27	0.9	NA	0.006	0.67	NA	0.013	0.5	NA
MATAURA	Waikaia River at Waipounamu Bridge Road	0.66	**2.2**	Indeterminate	0.007	0.78	Improvement	0.013	0.5	Improvement
MATAURA	Longridge Stream at Sandstone	4.1	**6.6**	NA	0.0335	**3.4**	NA	0.0595	**1.8**	NA
MATAURA	North Peak Stream at Waimea Valley Road	0.78	**1.3**	NA	0.015	**1.5**	NA	0.0355	**1.1**	NA
MATAURA	Sandstone Stream at Kingston Crossing Rd	2.25	**3.6**	NA	0.0435	**4.4**	NA	0.0735	**2.2**	NA
MATAURA	Waimea Stream at Mandeville	3.6	**5.8**	NA	0.018	**1.8**	NA	0.04	**1.2**	NA
MATAURA	Waikawa River at Progress Valley	0.96	**1.6**	Indeterminate	0.013	**1.3**	Indeterminate	0.038	**1.2**	Indeterminate
MATAURA	Waikopikopiko Stream at Haldane	0.33	0.5	NA	0.009	0.9	NA	0.018	0.5	NA
MATAURA	Tokanui River at Fortrose Otara Road	1.48	**2.4**	NA	0.019	**1.9**	NA	0.062	**1.9**	NA
MATAURA	Waituna Creek at Marshall Road	2.1	**3.4**	Indeterminate	0.015	**1.5**	Improvement	0.043	**1.3**	Improvement
MATAURA	Moffat Creek at Moffat Road	1.3	**2.1**	NA	0.07	**7**	NA	0.148	**4.5**	NA
MATAURA	Carran Creek at Waituna Lagoon Road	1.09	**1.8**	NA	0.044	**4.4**	NA	0.118	**3.6**	NA
ORETI	Oreti River at Three Kings	0.0911	0.3	NA	0.002	0.2	NA	0.0035	0.1	NA
ORETI	Cromel Stream at Selbie Road	0.0836	0.3	NA	0.0016	0.2	NA	0.004	0.2	NA
ORETI	Irthing Stream at Ellis Road	1.635	**5.5**	Deterioration	0.003	0.3	NA	0.008	0.3	NA
ORETI	Oreti River at Lumsden (NIWA)	0.7215	**2.4**	Deterioration	0.003	0.3	Indeterminate	0.005	0.2	Indeterminate
ORETI	Oreti River at Lumsden Bridge (ES)	0.72	**2.4**	NA	0.0025	0.3	NA	0.005	0.2	NA
ORETI	Otapiri Stream at Otapiri Gorge	0.83	**2.8**	Deterioration	0.0165	**1.8**	Indeterminate	0.036	**1.4**	Indeterminate

FMU	Site	Total Nitrogen State g/m³	Total Nitrogen Magnitude of exceedance	Total Nitrogen Trend (17 yr)	Dissolved Reactive Phosphorous State g/m³	Dissolved Reactive Phosphorous Magnitude of exceedance	Dissolved Reactive Phosphorous Trend (17 yr)	Total Phosphorus State g/m³	Total Phosphorus Magnitude of exceedance	Total Phosphorus Trend (17 yr)
	Bog Burn d/s Hundred Line Road	1.495	**2.4**	Deterioration	0.0275	**2.8**	NA	0.0505	**1.5**	NA
	Makarewa River at Lora Gorge Road	0.97	**1.6**	Indeterminate	0.014	**1.4**	Deterioration	0.0315	1.0	Indeterminate
	Makarewa River at Wallacetown	1.56	**2.5**	Indeterminate	0.0185	**1.9**	Indeterminate	0.0475	**1.4**	Indeterminate
	Oreti River at Riverton HW Br (NIWA)	1.123	**3.8**	Deterioration	0.005	0.6	Indeterminate	0.015	0.6	Indeterminate
	Oreti River at Wallacetown (ES)	1.16	**3.9**	NA	0.006	0.7	NA	0.012	0.5	NA
	Dunsdale Stream at Dunsdale Reserve	0.295	1.0	Indeterminate	0.01	**1.1**	Improvement	0.019	0.7	Indeterminate
	Winton Stream at Lochiel	2.35	**3.8**	Indeterminate	0.057	**5.7**	Indeterminate	0.1195	**3.6**	Indeterminate
	Tussock Creek at Cooper Road	2.05	**3.3**	Indeterminate	0.027	**2.7**	Indeterminate	0.05	**1.5**	Indeterminate
	Waikiwi Stream at North Road	3.35	**5.4**	Deterioration	0.011	**1.1**	Improvement	0.0305	0.9	Improvement
	Waihopai River u/s Queens Drive	2.9	**4.7**	Indeterminate	0.01	1.0	Improvement	0.0285	0.9	Improvement
	Otepuni Creek at Nith Street	1.99	**3.2**	Improvement	0.014	**1.4**	Indeterminate	0.038	**1.2**	Improvement
	Mokotua Stream at Awarua	0.7	**1.1**	Indeterminate	0.0025	0.25	NA	0.014	0.42	NA
APARIMA	Aparima River at Dunrobin	0.11	0.4	Indeterminate	0.0027	0.3	Improvement	0.004	0.2	Improvement
	Aparima River at Thornbury	0.92	**1.5**	Indeterminate	0.0065	0.7	NA	0.015	0.5	Indeterminate
	Otautau Stream at Waikouro	1.215	**2.0**	Indeterminate	0.0205	**2.1**	NA	0.0545	**1.7**	NA
	Otautau Stream at Otautau-Tuatapere Rd	1.28	**2.1**	Indeterminate	0.023	**2.3**	Improvement	0.053	**1.6**	Indeterminate
	Cascade Stream at Pourakino Valley Rd	0.165	0.3	Improvement	0.002	0.2	NA	0.007	0.2	NA
	Opouriki Stream at Tweedie Rd	2.3	**3.7**	Deterioration	0.01	1.0	NA	0.036	**1.1**	NA
	Pourakino River at Traill Road	0.375	0.6	Indeterminate	0.003	0.3	NA	0.013	0.4	NA
	Waimatuku Stream at Lorneville Riverton	3.8	**6.2**	Indeterminate	0.042	**4.2**	NA	0.0605	**1.8**	NA
WAIAU	Mararoa River at South Mavora Lake	0.0642	0.2	NA	NA	NA	NA	0.003	0.1	NA
	Mararoa River at Weir Road	0.515	**1.7**	Deterioration	NA	NA	NA	0.004	0.2	NA
	Mararoa River at The Key	0.25	0.8	Indeterminate	0.001	0.1	NA	0.0036	0.1	NA
	Whitestone River d/s Manapouri-Hillside	0.65	**2.2**	NA	0.002	0.2	NA	0.004	0.2	NA
	Monowai below Gates (NIWA)	0.26	0.9	Improvement	0.0008	0.1	NA	0.003	0.1	Indeterminate
	Waiau River at Sunnyside	0.26	0.9	Deterioration	NA	NA	NA	0.0037	0.1	NA
	Waiau at Tuatapere (NIWA)	0.36	**1.2**	Deterioration	0.001	0.1	Indeterminate	0.01	0.4	Indeterminate
	Waiau River at Tuatapere (ES)	0.38	**1.3**	NA	0.0015	0.2	NA	0.006	0.2	NA
	Orauea River at Orawia Pukemaori Road	0.795	**1.3**	NA	0.011	**1.1**	NA	0.028	0.8	NA
	Upukerora River at Te Anau-Milford Road	0.24	0.8	Indeterminate	0.0022	0.2	NA	0.0055	0.2	NA

5 a: Toxicity (Nitrate and Ammonia) state and trends by FMU. (Data source: LAWA. State 2013-2017, Trends 2008-2017). Note: state medians are shaded green if they fall within the ecosystem health ANZECC guidelines trigger value (for lowland sites), and red if they exceed.

FMU	Site	TON [Nitrate] NOF toxicity	TON [Nitrate] State Median g/m^3	TON [Nitrate] Magnitude of exceedance (ecosystem health)	TON [Nitrate] Trend (10 year)	Ammoniacal N NOF toxicity	Ammoniacal N State Median g/m^3	Ammoniacal N Magnitude of exceedance (ecosystem health)	Ammoniacal N Trend (10 year)
MATAURA	Mataura River at Parawa	A	0.335	0.8	Very likely degrading	A	0.005	0.2	NA
	Waikaia River u/s Piano Flat	A	0.01	0.0	Likely degrading	A	0.005	0.2	NA
	Waikaia River at Waikaia	A	0.1295	0.3	Indeterminate	A	0.005	0.2	Likely improving
	Waikaia River at Waipounamu Bridge Road	A	0.51	**1.1**	Likely degrading	A	0.005	0.2	Indeterminate
	Longridge Stream at Sandstone	C	3.6	**8.1**	Very likely degrading	A	0.0125	0.6	likely degrading
	North Peak Stream at Waimea Valley Road	B	0.285	0.6	Very Likely improving	A	0.01	0.5	Very Likely improving
	Sandstone Stream at Kingston Crossing Rd	C	1.195	**2.7**	Indeterminate	A	0.0115	0.5	NA
	Waimea Stream at Mandeville	C	3.05	**6.9**	Very likely degrading	A	0.005	0.2	Indeterminate
	Otamita Stream at Mandeville	B	0.72	**1.6**	Likely improving	A	0.005	0.2	Very Likely improving
	Mataura River at Gore	A	0.89	**2.0**	Indeterminate	A	0.005	0.2	Indeterminate
	Waikaka Stream at Gore	B	0.745	**1.7**	Very Likely improving	A	0.042	**2.0**	Very likely improving
	Mataura River 200m d/s Mataura Bridge	A	0.89	**2.0**	Likely improving	A	0.04	**1.9**	Indeterminate
	Mimihau Stream Tributary at Venlaw Forest	A	0.146	0.3	NA	A	0.005	0.2	NA
	Mimihau Stream at Wyndham	A	0.86	**1.9**	Indeterminate	A	0.005	0.2	Likely degrading
	Mokoreta River at Wyndham River Road	B	1.04	**2.3**	Likely improving	A	0.005	0.2	NA
	Mataura River at Mataura Island Bridge	B	0.89	**2.0**	Very Likely improving	A	0.013	0.6	NA
	Oteramika Stream at Seaward Downs	C	1.74	**3.9**	Very likely degrading	A	0.0455	**2.2**	Very likely degrading
	Waikawa River at Progress Valley	A	0.585	**1.3**	Very Likely improving	A	0.012	0.6	NA
	Tokanui River at Fortrose Otara Road	B	1.045	**2.4**	Very Likely improving	A	0.021	1.0	NA
	Waikopikopiko Stream Haldane Curio Bay	A	0.147	0.3	Very Likely improving	A	0.005	0.2	Very likely degrading
	Waituna Creek at Marshall Road	B	1.045	**2.4**	Very Likely improving	A	0.0185	0.9	Very Likely improving
	Carran Creek at Waituna Lagoon Road	A	0.305	0.7	Very Likely improving	A	0.045	**2.1**	Very Likely improving
ORETI	Oreti River at Three Kings	A	0.03	0.1	Very Likely improving	A	0.005	0.2	NA
	Cromel Stream at Selbie Road	A	0.008	0.0	Very likely degrading	A	0.005	0.2	Likely degrading
	Irthing Stream at Ellis Road	B	1.465	**3.3**	Likely degrading	A	0.005	0.2	Indeterminate
	Oreti River at Lumsden Bridge	A	0.589	**1.3**	Likely improving	A	0.005	0.2	NA
	Otapiri Stream at Otapiri Gorge	B	0.485	**1.1**	Indeterminate	A	0.005	0.2	Likely degrading
	Bog Burn d/s Hundred Line Road	B	0.91	**2.0**	Very Likely improving	A	0.015	0.7	NA
	Makarewa River at Lora Gorge Road	A	0.535	**1.2**	Indeterminate	A	0.005	0.2	Very likely degrading
	Dunsdale Stream at Dunsdale Reserve	A	0.173	0.4	Likely degrading	A	0.005	0.2	NA

FMU	Site	TON [Nitrate]				Ammoniacal N			
		NOF toxicity	State Median g/m³	Magnitude of exceedance (ecosystem health)	Trend (10 year)	NOF toxicity	State Median g/m³	Magnitude of exceedance (ecosystem health)	Trend (10 year)
	Winton Stream at Lochiel	C	1.52	**3.4**	Very Likely improving	B	0.107	**5.1**	Very likely degrading
	Tussock Creek at Cooper Road	B	1.27	**2.9**	Very Likely improving	B	0.0245	**1.2**	Likely improving
	Makarewa River at Wallacetown	B	0.895	**2.0**	Very Likely improving	B	0.0495	**2.4**	Likely improving
	Oreti River at Wallacetown	B	0.94	**2.1**	NA	A	0.005	0.2	NA
	Waikiwi Stream at North Road	C	2.65	**6.0**	Likely improving	A	0.019	0.9	NA
	Waihopai River u/s Queens Drive	C	1.995	**4.5**	Very Likely improving	A	0.0165	0.8	Very Likely improving
	Otepuni Creek at Nith Street	B	1.165	**2.6**	Very Likely improving	A	0.0535	**2.5**	Very likely degrading
	Mokotua Stream at Awarua	A	0.02	0.0	NA	NA	0.005	0.2	Very Likely improving
APARIMA	Aparima River at Dunrobin	A	0.025	0.1	Indeterminate	A	0.005	0.2	NA
	North Etal Stream u/s Dunrobin Valley Rd	B	0.425	1.0	NA	A	0.005	0.2	NA
	Otautau Stream at Waikouro	B	**0.79**	**1.8**	Very Likely improving	A	0.0225	**1.1**	Very Likely improving
	Otautau Stream at Otautau-Tuatapere Road	B	**0.705**	**1.6**	Very Likely improving	A	0.026	**1.2**	Indeterminate
	Aparima River at Thornbury	B	**0.665**	**1.5**	Very Likely improving	A	0.005	0.2	NA
	Cascade Stream at Pourakino Valley Road	A	0.016	0.0	NA	A	0.005	0.2	NA
	Opouriki Stream at Tweedie Road	B	1.805	**4.1**	Very likely degrading	A	0.021	1.0	NA
	Pourakino River at Traill Road	A	0.17	0.4	Very likely degrading	A	0.012	0.6	Indeterminate
WAIAU	Mararoa River at South Mavora Lake	A	0.005	0.0	NA	A	0.005	0.2	NA
	Upukerora River at Te Anau-Milford Road	A	0.143	0.3	Likely improving	A	0.005	0.2	Very Likely improving
	Whitestone River d/s Manapouri-Hillside	A	0.49	**1.1**	Likely degrading	A	0.005	0.2	Likely improving
	Mararoa River at The Key	A	0.119	0.3	Likely improving	A	0.005	0.2	Indeterminate
	Mararoa River at Weir Road	A	0.395	0.9	Indeterminate	A	0.005	0.2	Likely degrading
	Waiau River at Sunnyside	A	0.1665	0.4	Very likely degrading	A	0.005	0.2	NA
	Lill Burn at Lill Burn-Monowai Road	A	0.0575	0.1	NA	A	0.005	0.2	NA
	Orauea River at Orawia Pukemaori Road	A	0.415	0.9	Likely improving	A	0.005	0.2	NA
	Waiau River at Tuatapere	A	0.2485	0.6	Indeterminate	A	0.003	0.1	NA

5 b: Nutrients (TN, TP, DRP) state and trends by FMU. (Data source: LAWA data. Data source: LAWA. State 2013-2017, Trends 2008-2017). Note: state medians are shaded green if they fall within the ecosystem health ANZECC guidelines trigger value (for lowland sites), and red if they exceed.

FMU	Site	TN			DRP			TP		
		State Median g/m³	Magnitude of exceedence	Trend	State Median g/m³	Magnitude of exceedence	Trend	State Median g/m³	Magnitude of exceedence	Trend
MATAURA	Mataura River at Parawa	0.413	0.7	Very likely degrading	0.005	0.5	Likely improving	0.009	0.3	Likely improving
	Waikaia River u/s Piano Flat	0.1	0.2	Likely degrading	0.004	0.4	Very likely degrading	0.008	0.2	Likely improving
	Waikaia River at Waikaia	0.285	0.5	Very likely degrading	0.006	0.6	Very likely degrading	0.012	0.4	Likely improving
	Waikaia River at Waipounamu Bridge Rd	0.665	1.1	Very likely degrading	0.006	0.6	Indeterminate	0.012	0.4	Likely improving
	Longridge Stream at Sandstone	4.25	6.9	Very likely degrading	0.033	3.3	Indeterminate	0.056	1.7	Very Likely improving
	North Peak Stream at Waimea Valley Rd	0.815	1.3	Very Likely improving	0.016	1.6	Very likely degrading	0.0345	1.0	Very Likely improving
	Sandstone Stream at Kingston Crossing Rd	2.095	3.4	Likely improving	0.042	4.2	Very likely degrading	0.0735	2.2	Indeterminate
	Waimea Stream at Mandeville	3.75	6.1	Very likely degrading	0.0215	2.15	Indeterminate	0.044	1.3	Likely improving
	Otamita Stream at Mandeville	0.99	1.6	Likely improving	0.01	1	Indeterminate	0.028	0.8	Indeterminate
	Mataura River at Gore	1.1	1.8	Likely degrading	0.006	0.6	Indeterminate	0.0155	0.5	Indeterminate
	Waikaka Stream at Gore	1.33	2.2	Indeterminate	0.024	2.4	Very Likely improving	0.0535	1.6	Very Likely improving
	Mataura River 200m d/s Mataura Bridge	1.15	1.9	Indeterminate	0.01	1	Very Likely improving	0.02	0.6	Very Likely improving
	Mimihau Stream Tributary at Venlaw	0.27	0.4	NA	0.012	1.2	NA	0.02	0.6	NA
	Mimihau Stream at Wyndham	1.16	1.9	Indeterminate	0.012	1.2	Likely improving	0.036	1.1	Very Likely improving
	Mokoreta River at Wyndham River Road	1.36	2.2	Very Likely improving	0.008	0.8	Very Likely improving	0.026	0.8	Very Likely improving
	Mataura River at Mataura Island Bridge	1.17	1.9	Indeterminate	0.009	0.9	Very Likely improving	0.021	0.6	Very Likely improving
	Oteramika Stream at Seaward Downs	2.75	4.5	Very likely degrading	0.035	3.5	Very likely degrading	0.097	2.9	Likely degrading
	Waikawa River at Progress Valley	0.95	1.5	Very Likely improving	0.013	1.3	Indeterminate	0.0345	1.0	Very Likely improving
	Tokanui River at Fortrose Otara Road	1.44	2.3	Likely improving	0.019	1.9	Indeterminate	0.056	1.7	Very Likely improving
	Waikopikopiko Stream at Haldane	0.33	0.5	Very Likely improving	0.009	0.9	Very likely degrading	0.019	0.6	Likely improving
	Waituna Creek at Marshall Road	1.78	2.9	Very Likely improving	0.014	1.4	Very Likely improving	0.039	1.2	Very Likely improving
	Carran Creek at Waituna Lagoon Road	1.11	1.8	Likely improving	0.0465	4.65	Likely degrading	0.1185	3.6	Likely improving

FMU	Site	TN			DRP			TP		
		State Median g/m^3	Magnitude of exceedence	Trend	State Median g/m^3	Magnitude of exceedence	Trend	State Median g/m^3	Magnitude of exceedence	Trend
ORETI	Oreti River at Three Kings	0.055	0.1	NA	0.002	0.2	Very Likely improving	0.002	0.1	Indeterminate
	Cromel Stream at Selbie Road	0.055	0.1	Likely degrading	0.002	0.2	NA	0.002	0.1	Very likely degrading
	Irthing Stream at Ellis Road	1.645	2.7	Indeterminate	0.002	0.2	NA	0.002	0.1	Indeterminate
	Oreti River at Lumsden Bridge	0.72	1.2	Likely improving	0.002	0.2	NA	0.002	0.1	Indeterminate
	Otapiri Stream at Otapiri Gorge	0.83	1.4	Indeterminate	0.0175	1.75	Very likely degrading	0.0175	0.5	Indeterminate
	Bog Burn d/s Hundred Line Road	1.38	2.2	Very Likely improving	0.0275	2.75	Very likely degrading	0.0275	0.8	Very likely degrading
	Makarewa River at Lora Gorge Road	0.935	1.5	Likely degrading	0.014	1.4	Likely degrading	0.014	0.4	Indeterminate
	Dunsdale Stream at Dunsdale Reserve	0.295	0.5	Very likely degrading	0.01	1	Likely degrading	0.01	0.3	Likely degrading
	Winton Stream at Lochiel	2.4	3.9	Very Likely improving	0.0595	5.95	Likely improving	0.0595	1.8	Likely improving
	Tussock Creek at Cooper Road	2	3.3	Very Likely improving	0.029	2.9	Indeterminate	0.029	0.9	Likely improving
	Makarewa River at Wallacetown	1.385	2.3	Very Likely improving	0.019	1.9	Indeterminate	0.019	0.6	Very Likely improving
	Oreti River at Wallacetown	1.13	1.8	NA	0.006	0.6	NA	0.006	0.2	NA
	Waikiwi Stream at North Road	3.3	5.4	Likely improving	0.011	1.1	Indeterminate	0.011	0.3	Very Likely improving
	Waihopai River u/s Queens Drive	2.8	4.6	Very Likely improving	0.009	0.9	Very Likely improving	0.009	0.3	Very Likely improving
	Otepuni Creek at Nith Street	1.95	3.2	Very Likely improving	0.014	1.4	Likely degrading	0.014	0.4	Very Likely improving
	Mokotua Stream at Awarua	0.7	1.1	Very Likely improving	0.002	0.2	Very Likely improving	0.002	0.1	Very Likely improving
APARIMA	Aparima River at Dunrobin	0.11	0.2	NA	0.002	0.2	Indeterminate	0.004	0.2	Very Likely improving
	North Etal Stream u/s Dunrobin Valley Rd	0.64	1.0	NA	0.0045	0.45	NA	0.014	0.7	NA
	Otautau Stream at Waikouro	1.215	2.0	Very Likely improving	0.021	2.1	Likely improving	0.0535	1.6	
	Otautau Stream at Otautau-Tuatapere Rd	1.23	2.0	Likely improving	0.0235	2.35	Likely degrading	0.051	1.5	Likely improving
	Aparima River at Thornbury	0.91	1.5	Very Likely improving	0.006	0.6	Likely improving	0.014	0.4	Very Likely improving
	Cascade Stream at Pourakino Valley Rd	0.17	0.3	Likely degrading	0.002	0.2	NA	0.007	0.2	Likely improving
	Opouriki Stream at Tweedie Road	2.2	3.6	Likely degrading	0.01	1	Indeterminate	0.034	1.0	Likely improving

FMU	Site	TN			DRP			TP		
		State Median g/m³	Magnitude of exceedence	Trend	State Median g/m³	Magnitude of exceedence	Trend	State Median g/m³	Magnitude of exceedence	Trend
	Pourakino River at Traill Road	0.37	0.6	Indeterminate	0.002	0.2	Likely improving	0.013	0.4	Very likely improving
WAIAU	Mararoa River at South Mavora Lake	0.055	0.1	Indeterminate	0.002	0.2	NA	0.002	0.1	Indeterminate
	Upukerora River at Te Anau-Milford Road	0.25	0.4	Likely degrading	0.002	0.2	NA	0.006	0.2	Likely degrading
	Whitestone River d/s Manapouri-Hillside	0.65	**1.1**	Very likely degrading	0.002	0.2	Likely degrading	0.005	0.2	Likely degrading
	Mararoa River at The Key	0.255	0.4	Indeterminate	0.002	0.2	NA	0.002	0.1	Very Likely improving
	Mararoa River at Weir Road	0.52	0.8	Indeterminate	0.002	0.2	NA	0.004	0.1	Likely improving
	Waiau River at Sunnyside	0.27	0.4	Very likely degrading	0.002	0.2	NA	0.002	0.1	Likely improving
	Lill Burn at Lill Burn-Monowai Road	0.265	0.4	NA	0.004	0.4	NA	0.016	0.5	**NA**
	Orauea River at Orawia Pukemaori Rd	0.73	**1.2**	Indeterminate	0.011	**1.1**	Indeterminate	0.0275	0.8	Very Likely improving
	Waiau River at Tuatapere	0.363	0.6	Very likely degrading	0.001	0.1	NA	0.006	0.2	Indeterminate

Table 6: NOF Attribute States of Monitored Southland Lakes (Data source: Hodson et al. 2017. State: Jan 2012 – Dec 2016))

FMU	Site	Total Nitrogen (Trophic State)	Total Phosphorus (Trophic State)	Phytoplankton [chlorophyll-a] (Trophic State)	Ammonia (Toxicity)	E. Coli (Human Health) Primary contact (2014 version of the NOF)
MATAURA	Waituna_open	C	C	B	B	D
	Waituna_closed	D	C	C	A	D
	Lake Vincent	D	C	B	B	A
	The Reservoir	C	C	D	A	A
ORETI	Lake Murihiku	NA	NA	NA	NA	NA
APARIMA	Uruwera/Lake George	C	C	B	B	C
WAIAU	Lake Manapouri	A	A	A	A	A
	Lake Te Anau	A	A	A	A	A